NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

USABLE KNOWLEDGE GAINED FOR PERSONNEL SERVING IN THE OPERATING FORCES THROUGH NAVAL POSTGRADUATE SCHOOL'S DISTRIBUTED LEARNING PROGRAM

by

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June 2006

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REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.			
1. AGENCY USE ONLY ***(Leave blank)***	**2. REPORT DATE** June 2006	**3. REPORT TYPE AND DATES COVERED** Master's Thesis	
4. TITLE AND SUBTITLE: Usable Knowledge Gained or Refined for Personnel Serving in the Operating Forces Through Naval Postgraduate School's Distributed Learning Program			**5. FUNDING NUMBERS**
6. AUTHOR(S) Billy s. Hortman			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000			**8. PERFORMING ORGANIZATION REPORT NUMBER**
9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A			**10. SPONSORING/MONITORING AGENCY REPORT NUMBER**
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.			
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.			**12b. DISTRIBUTION CODE**

13. ABSTRACT (maximum 200 words)

This research examines the usable knowledge gained or refined through Distributed Learning from Naval Postgraduate School for personnel serving in operational billets. The population studied was students currently enrolled or students that had completed the Information Systems and Operations certificate program. The study used a web based survey for data collection and used that data to answer four research questions. The data clearly demonstrates that Distributed Learning is equivalent to resident coursework in terms of usable knowledge gained or refined and distributes that usable knowledge quickly and efficiently to individual servicemembers. Beyond the individual, a direct transfer to the organization of a portion of the knowledge gained or refined occurs. The data suggest that frequency of use of skills can be used as a measure of effectiveness for the Distributed Learning program at Naval Postgraduate School, but more data are needed to be conclusive. Additionally, the results provide evidence that Distributed Learning provides a strong, social interaction learning context. This evidence challenges the assertion that social interaction between students and faculty is primarily a characteristic of resident coursework and a limitation of Distributed Learning.

14. SUBJECT TERMS Distributed Learning, Distance Learning, Graduate Education, Graduate Skills, Naval Postgraduate School, NPS, Information Technology Management, Graduate Certificate, Frequency of Use, Knowledge Gained or Refined, Skills Gained or Refined, Knowledge Value Analysis			**15. NUMBER OF PAGES** 117
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	**18. SECURITY CLASSIFICATION OF THIS PAGE** Unclassified	**19. SECURITY CLASSIFICATION OF ABSTRACT** Unclassified	**20. LIMITATION OF ABSTRACT** UL

NSN 7540-01-280-5500 Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

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USABLE KNOWLEDGE GAINED FOR PERSONNEL SERVING IN THE OPERATING FORCES THROUGH NAVAL POSTGRADUATE SCHOOL'S DISTRIBUTED LEARNING PROGRAM

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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN INFORMATION TECHNOLOGY MANAGEMENT

from the

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This research examines the usable knowledge gained or refined through Distributed Learning from Naval Postgraduate School for personnel serving in operational billets. The population studied was students currently enrolled or students that had completed the Information Systems and Operations certificate program. The study used a web based survey for data collection and used that data to answer four research questions. The data clearly demonstrates that Distributed Learning is equivalent to resident coursework in terms of usable knowledge gained or refined and distributes that usable knowledge quickly and efficiently to individual servicemembers. Beyond the individual, a direct transfer to the organization of a portion of the knowledge gained or refined occurs. The data suggest that frequency of use of skills can be used as a measure of effectiveness for the Distributed Learning program at Naval Postgraduate School, but more data are needed to be conclusive. Additionally, the results provide evidence that Distributed Learning provides a strong, social interaction learning context. This evidence challenges the assertion that social interaction between students and faculty is primarily a characteristic of resident coursework and a limitation of Distributed Learning.

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ACKNOWLEDGMENTS

For Celeste, Mo, and Lilly, thank you for your patience and support. All of the good things in my life are reflections of you. I love you.

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I. INTRODUCTION

The current trend in manpower management and systems development in the operating forces is towards exploiting emerging technologies to minimize redundant effort and streamline processes with the intended result of maximizing efficiency. More efficient systems and processes move towards the desired state of employing the bulk of resources available to war-fighting competencies or direct support of war-fighting competencies and reducing requirements of competing efforts for those resources in support roles. Harnessing emerging technologies and applying them thoughtfully provides more precision and economy of force with less dedicated resources, both in manpower and systems. This provides the operating forces with increased flexibility as world-wide commitments and contingencies continue to grow. Implementation of new technologies requires resident knowledge in order to succeed. While contractor support is invaluable and necessary, it is a finite resource and does not replace the need for that knowledge as an organic asset. Graduate-level education is one means to develop and maintain this organic knowledge base. The United States Navy (Navy) promotes educational opportunities to include graduate education for its members primarily to develop and maintain this base. A central concern for the Navy is the question of how to obligate finite resources to maximize the benefits of graduate education for the organization. [Filizetti 2003].

The question of how to best allocate financial and manpower resources to maximize graduate education benefits begins with an analysis of available methods to provide that education. For both the Navy and the United States Marine Corps (USMC), the primary means of attaining the organizational resource of organic graduate-trained personnel is resident coursework at the Naval Postgraduate School (NPS). "The mission of the Naval Postgraduate School is to provide relevant and unique advanced education and research programs in order to increase the combat effectiveness of U.S. and Allied armed forces and enhance the security of the United States." [NPS 2005]. Resident coursework, no matter how effective, has some limitations in terms of application in the Fleet.

First, a service loses the use of an officer for up to twenty- seven months while that officer is attending NPS. Second, graduates may not report to billets that apply their new skill sets directly to the tactical concerns of the operating forces. Distributed Learning (DL) at NPS is a means available to the services that address the limitations of resident coursework at NPS. DL is administered at NPS by the Office of Continuous Learning (OCL). "The mission of the OCL is to coordinate and administer innovative and cost-effective efforts to identify, package and deliver the intellectual capital of NPS to the Navy and Department of Defense (DoD) decision-makers and other component personnel who are not able to attend NPS on a full- time residential basis" [NPS 2005].

Accepting DL coursework as a viable alternative to resident study at NPS for the individual services requires qualitative and quantitative measures that demonstrate NPS's ability to provide needed graduate-level skills to personnel in the operating forces. Without a demonstrated measure of usable knowledge gained, the flexibility and convenience of DL coursework from NPS become the primary incentive for an organization to sponsor an officer's study. In effect, the organization then loses the benefit of the social interaction and development recognized as a valuable but indefinable aspect of resident study that helps students "convert their tacit knowledge into explicit knowledge" [Na Ubon 2002], while at the same time potentially not gaining a specific, tangible learning outcome that targets needed skills for that organization. Essentially, the organization is in a position that requires commitment of resources with no specified or expected return. This need to develop a measure for the successful transfer of usable knowledge via DL is the genesis of this research.

Measuring the specific value of DL coursework for personnel and organizations in the operating forces begins with the basic question of whether DL coursework is comparable to resident study. Acknowledging the challenges in time and space associated with any DL program, comparing learning outcomes between a resident and DL class for the same course provides insight into this basic question. In fact, academic evidence exists that learning outcomes between resident and non-resident work can be comparable [Johnson 2000]. A blind study review conducted at the University of Illinois at Urbana-Champaign reported no significant statistical difference between final project evaluations between a resident and DL group of students taking the same course [Johnson

2000]. Assuming equivalence between resident and DL coursework, the primary question becomes what parameter is best suited to measure DL effectiveness for the operating forces.

Understanding student preference impact on survey results and potential organizational bias from resource allocation become important considerations when determining a concrete measure of usable knowledge gained via DL work. Comparing learning objectives for a DL course to the actual learning outcomes used in performance of billet requirements in the operating forces is the key to isolating a quantitative measure of effectiveness. Specifically, frequency of use of learning outcomes gained through DL work provides a potential means and measure of NPS DL success in providing timely, usable knowledge to the forward edge of the operating forces. Frequency of use of specific skill sets to demonstrate usable knowledge gained in a graduate environment has a research precedent for resident study at NPS [Branstetter 2002].

Working from the position that graduate skills at a Master's level is finding more and more application in the operating forces as technology advances and that resident coursework at NPS does have some drawbacks for organizations in the operating forces, NPS's DL programs provide a potential means for effectively meeting the need for graduate skill sets in the Fleet billets. By measuring the effectiveness of DL in terms of usable knowledge gained, receiving organizations as well as the NPS DL program benefit. The former gets a way to measure return on investment or at least an expectation of results. The latter receives input that aids tailoring individual programs to maximize results for the operating forces. Interestingly, DL students learning a specific skill set that they are simultaneously reinforcing in billet performance may actually maintain a higher level of retention than students that gain the same skills in a strictly academic setting [Conway 1991]. Providing a method to assess the effectiveness of DL coursework within the operating forces in terms of usable knowledge gained is the ultimate aim of this research and intended to help the NPS DL program provide the most responsive product possible to personnel serving in the operating forces.

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II. KNOWLEDGE CREATION

In the Information Age, managing knowledge better than rivals provides a distinct competitive advantage for an organization regardless of the specific field or endeavor in this day and age. The Armed Forces are no different. Management of knowledge in the ever-changing technological environment at the tactical level coupled with the requirement for mission success demands a concentrated effort to maximize the knowledge within the operating forces. A critical aspect of knowledge management in the operating forces is an acknowledgement of the nature of the work force. Generally, individuals are trained to perform specific, highly technical tasks without an understanding of the larger picture of how the other systems and sub-systems interrelate to meet the larger mission. In this situation, where multiple processes that are implemented individually but designed to provide a synergistic result, the organization must contain a sufficient level of knowledge to manage the integration of the separate efforts in order to be successful. While organizational knowledge contains many aspects, the basic building block of organizational knowledge is creation of new knowledge.

A. ORGANIZATIONAL KNOWLEDGE CREATION THEORY

Based upon the quantity and logical progression of the research conducted in this area by Ikujiro Nonaka, Ph.D. and the quality of his research as evidenced by the heavy citation of his work in other published research in this area, the Nonaka-based models' progression form the base of this research's literature review. This literature review uses Nonaka-based organizational knowledge creation theory to compare and contrast other knowledge creation models with the intent of either reinforcing or rejecting elements of that theory within the perspective of this research effort. Accepting that knowledge is categorized as either tacit or explicit and that the summation of both held by an organization represents the total organic knowledge "owned" by that organization leads to an expectation that any model of knowledge creation requires addressing both categories. In fact, the interaction between these two categories of knowledge is the key ingredient in creating "new knowledge" internal to an organization [Nonaka 1994].

1. Four Modes of Knowledge Interaction Model

The Nonaka and Takeuchi model of knowledge creation considers four modes of interaction between explicit and tacit knowledge, which results in the creation of new knowledge. These four modes of interaction are described as follows: (1) tacit to tacit, (2) tacit to explicit, (3) explicit to tacit, (4) explicit to explicit. These modes of interaction are further developed through the means of interaction that results in the knowledge transfer and/or creation. Tacit to tacit knowledge creation is achieved through a process of socialization, which results from a transfer of experienced-based knowledge between individuals in an environment that reinforces that knowledge transfer such as on-the-job-training [Nonaka 1994]. Explicit to explicit knowledge creation occurs through a combination process, which results from an interaction of individuals in a collaborative environment where batches of explicitly held knowledge are combined to enhance organization knowledge and understanding in an area [Nonaka 1994]. Tacit to explicit knowledge creation occurs through an externalization process that is simply described as when tacit knowledge is codified in a manner where other individuals can access it for use without having to gain the knowledge though experience [Nonaka 1994]. Explicit to tacit knowledge creation occurs through an internalization process where an individual receives knowledge in explicit form and internalizes or learns that knowledge sufficiently to enhance his or her level of tacit knowledge in that area [Nonaka 1994].

Because internalization of knowledge is the mode of knowledge conversion that best correlates with individual learning through a DL format in relative terms to the focus of this research, it is the mode of the Nonaka and Takeuchi model that is of the most interest for this research effort. Internalization is more than just the conversion of explicit knowledge into tacit knowledge in one individual, knowledge that is internalized by an individual into their tacit knowledge base becomes an asset for the organization through such assets as shared mental models or technical know-how [Nonaka 2000].

Establishing that internalization of new knowledge occurs within an organization validates the potential that the newly acquired knowledge can initiate a new knowledge spiral within the organization. The Socialization, Externalization, Combination, and

Internalization (SECI) model depicted in Figure 1 contains a visual description of the interaction and relationships between the four modes of knowledge interaction [Nonaka 1994].

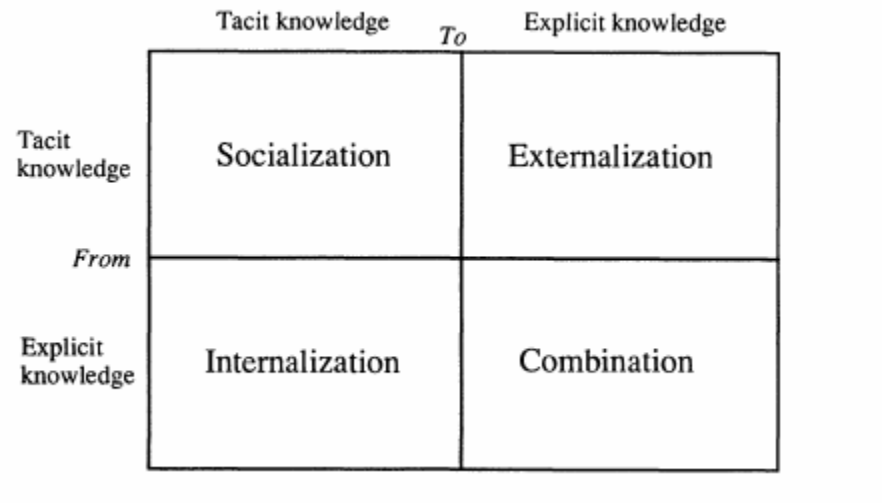


Figure 1. SECI Model (From Nonaka 1994)

a. Characteristics of Knowledge Transfers Between Explicit and Tacit Knowledge

Developing the assertion that knowledge conversion as explained by the SECI model occurs because of knowledge transfers between tacit and explicit knowledge bases in various modes presents the necessity to examine the ease of knowledge flow between those two types of knowledge. If the flow from explicit to tacit is relatively easy to recognize and capture as compared to the flow of tacit to explicit or vice versa, then that becomes a consideration in attempting to manage the knowledge creation process. If a disparity in the ease of knowledge flow based solely on the direction of that flow exists, then by extension some modes of knowledge conversion in the SECI model become more difficult to complete than others. Furthering this point is the intuitive consideration that a tacit to explicit knowledge flow is more difficult to enable than an explicit to tacit knowledge flow just because of the nature of tacit knowledge. Figure 2 depicts Inkpen and Dinur's assertion that as knowledge tacitness increases its ease of transferability decreases, especially as the scope of that transfer increases as well [Inkpen 1998].

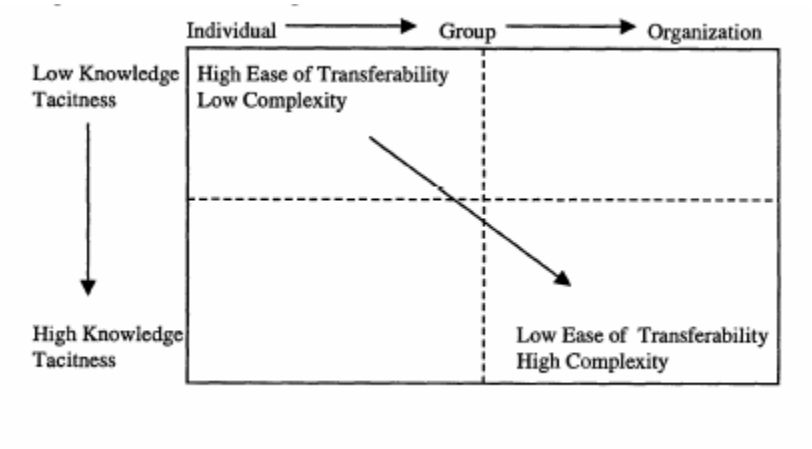


Figure 2. Knowledge Transfer Classification Framework (From Inkpen 1998)

b. Organizational Characteristics' Effect on Knowledge Transfer

Continuing to provide more amplification and theoretical support of the two types of knowledge and their interaction involves in terms of organizational knowledge creation requires some examination of the characteristics of organizations. Specifically, knowledge transfers differ based upon factors such as size and perspective of the receiving element of a knowledge transfer. Figure 2 alludes to this element of knowledge transfer in that it visually connects ease of transferability, complexity, and tacitiness of knowledge with individuals, groups, and organizations. Furthering this observation, Gunnar Hedlund recognizes four "agents of knowledge", which are related to the specific sub-sets of organizational relationships. He asserts that tacit and explicit knowledge, which he refers to as articulated knowledge, exists across all of the "agents of knowledge" and provides specific examples in Figure 3 [Hedlund 1994].

	INDIVIDUAL	GROUP	ORGANIZATION	INTERORGANIZATONAL DOMAIN
ARTICULATED KNOWLEDGE/ INFORMATION Cognitive Skills Embodied	Knowing calculus	Quality circle's documented analysis of its performance	Organization chart	Suppliers' patents and documented practices
TACIT KNOWLEDGE/ INFORMATION Cognitive Skills Embodied	Cross-cultural negotiation skills	Team coordination in complex work	Corporate culture	Customers' attitudes to products and expectations

Figure 3. Agents of Knowledge (From Hedlund 1994)

While practical application of knowledge transfers may be impacted by the direction of knowledge flows and organizational characteristics, the SECI model serves as a theoretical model to continue examination of the knowledge creation process. Nonaka and Takeuchi further develop their model of the interaction between the types of knowledge to represent the way new knowledge is created in an organization by these interactions. They describe the continuous interaction between tacit and explicit knowledge as a "spiral" that works to build new knowledge from existing knowledge. "While each of the four modes of knowledge creation can create new knowledge independently, the central theme of the model of organizational knowledge creation proposed here hinges on the dynamic interaction between the different modes of knowledge creation. That is to say, "knowledge creations centers on the building of tacit and explicit knowledge and, more importantly, on the interchange between those two aspects of knowledge through internalization and externalization" [Nonaka 1994].

2. Nonaka's Knowledge Spiral

The interaction between tacit and explicit knowledge providing the catalyst for new knowledge creation is supported by general observation as a supporting mechanism for the formal research in the area. In a generic military application, which is the intended environment of this research, a work section will have standard operating procedures (SOPs). When an individual arrives in a billet in that section, written procedures, SOPs, and written guidance provides a general understanding of the billet

responsibilities and billet procedures. That written direction, explicit in nature, coupled with the experience of his or her co-workers, aid in building a level of tacit knowledge. Over time, that individual becomes the subject matter expert and develops new techniques, tactics, and procedures (TTPs) for processes in his or her work section. Once those new TTPs are codified in written procedures and SOPs, that tacit knowledge, which was built upon existing explicit knowledge and nurtured by other individual's experiences (tacit knowledge), has become explicit in nature. That entire process occurs again and again over time and is an example of how the "knowledge spiral", i.e., the interaction between tacit and explicit knowledge through the externalization and internalization, builds new knowledge in an organization as depicted in Figure 4 [Nonaka 1994]. This knowledge spiral encompasses all four of the knowledge conversion modes as outlined in the SECI and demonstrates a relationship between the two types of knowledge; individuals and organizations; and the philosophical and metaphysical dimensions.

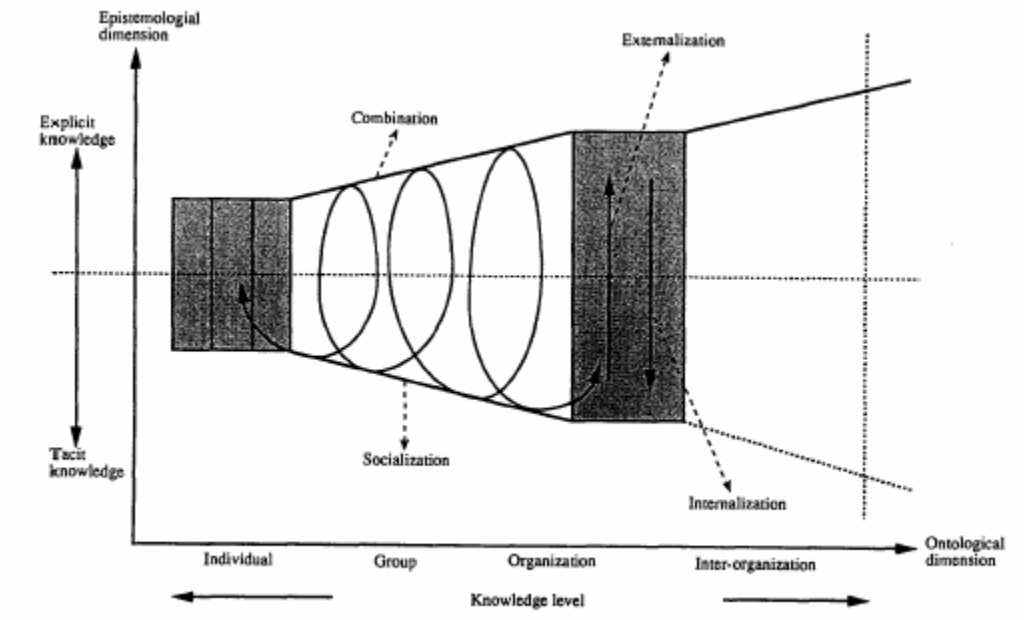


Figure 4. Knowledge Spiral (Nonaka 1994)

B. ORGANIZATIONAL KNOWLEDGE CONVERSION THEORY

While the knowledge spiral models the knowledge creations aspects of the interaction between tacit and explicit knowledge, it does not specifically address the environment and related intangible factors that influence the knowledge creation process. Specifically, the knowledge spiral describes the continuous exchange between tacit and explicit knowledge in the context of knowledge creation in an organization but does not directly model the crucial, contributing organizational elements of the process. Because knowledge creation in an organization is most certainly a dynamic process, a more robust model that captures those elements is necessary. Nonaka, along with Toyama and Konno, build upon Nonaka's previous work and propose a model that captures more of the contributing factors associated with the knowledge creation aspects of the knowledge spiral. Their proposed model is presented in Figure 5 [Nonaka 2000].

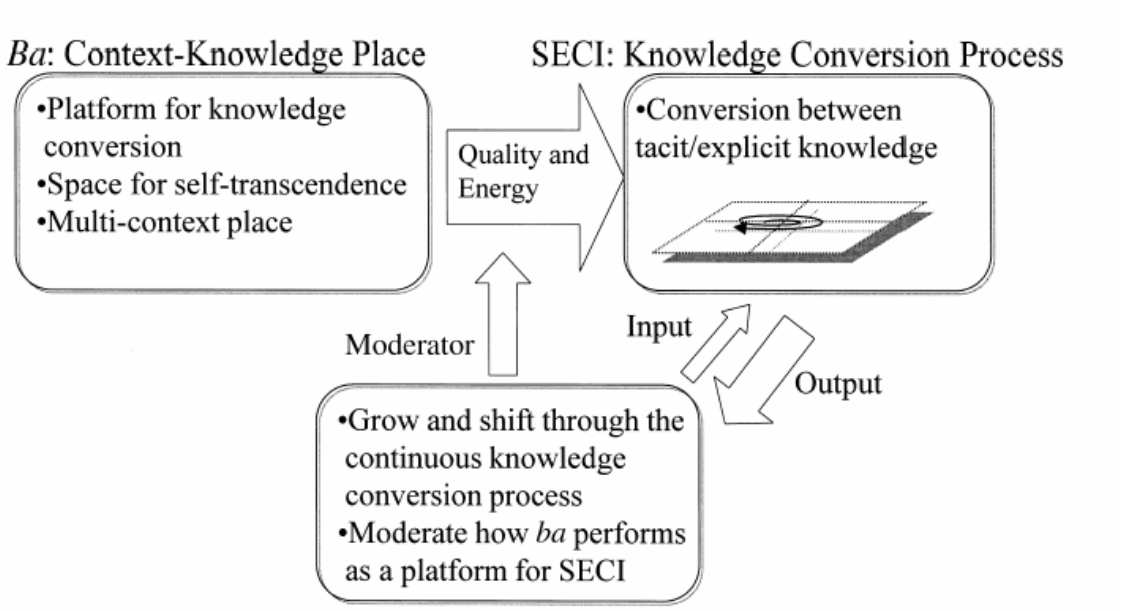


Figure 5. Organizational Knowledge Conversion Process (Nonaka 2000)

"This model consists of three elements: the SECI process, (i) knowledge creation through the conversion of tacit and explicit knowledge; (ii) ***ba*** the shared context for knowledge creation; and (iii) knowledge assets, the inputs, outputs and moderators of the knowledge-creation process." [Nonaka 2000].

1. Four Modes of Knowledge Interaction Model Including Descriptors

While the original SECI model presented by Nonaka and Takeuchi, which is depicted in Figure 1, demonstrates the knowledge conversion process, Nonaka, Toyama, and Konno updated the SECI model in their collective work. Their updated SECI model is presented in Figure 6 [Nonaka 2000]. While the basic premise of this model remains the same, Nonaka, Toyama, and Konno add descriptors to the conversion modes in the model. These descriptors are important additions to the model because they drive to the point that Nonaka, Toyama, and Konno pursue in that the three elements associated with the knowledge creation process as depicted in the model presented in Figure 6 operate interdependently and cannot be truly administered independently.

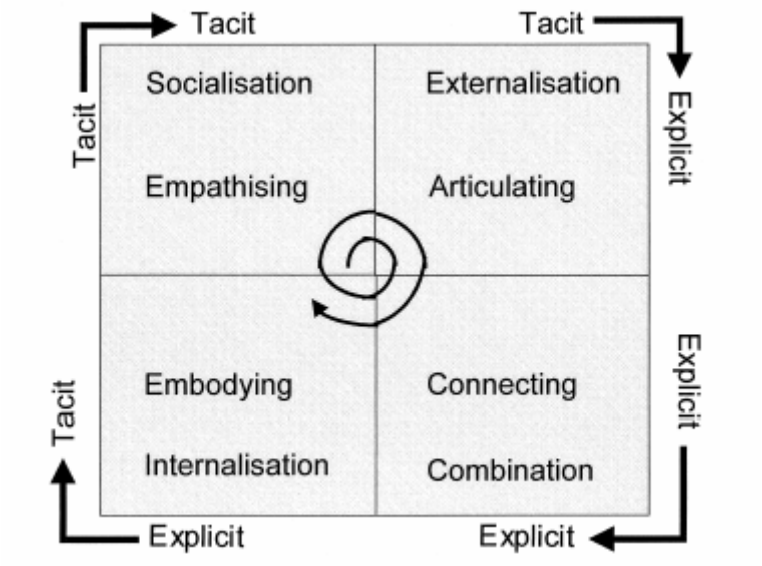


Figure 6. SECI Model with Descriptors (From Nonaka 2000)

Empathizing describes the key element of the socialization mode of conversion because it delineates the essential characteristic of knowledge transfer required to transfer tacit knowledge to tacit knowledge. "Since tacit knowledge is difficult to formalize and often time- and space-specific, tacit knowledge can be acquired only through shared experience, such as spending time together or living together in the same environment" [Nonaka 2000]. Essentially, an empathic conduit must be built between individuals prior to the transfer of tacit knowledge. Articulating is the key descriptor for the externalizing mode of knowledge conversion because it describes the single most necessary element

involved with a tacit knowledge to explicit knowledge conversion. Converting tacit to explicit knowledge requires the holder of the tacit knowledge to crystallize a portion of his or her relevant tacit knowledge base into a form that can be expressed and understood in an explicit format for the recipient of that knowledge transfer. "The successful conversion of tacit knowledge into explicit knowledge depends on the sequential use of metaphor, analogy, and model" [Nonaka 2000]. Connecting is the key descriptor for the combination mode of knowledge conversion. Converting explicit knowledge to other more usable or pertinent explicit knowledge sets requires taking inputs from a myriad of sources, potentially both internal and external to the organization, in order to generate new explicit knowledge for the organization. Database and network technologies are a key enabler of the required connectivity for this type of knowledge conversion [Nonaka 2000]. Embodying is the key descriptor for the internalization mode of knowledge conversion. Converting explicit knowledge to tacit knowledge requires an individual to add to his or her tacit knowledge base upon receipt of knowledge distributed in a codified format. Explicit knowledge is embodied through "hands-on" work coordinated with explicit knowledge inputs as well as simulations or situation specific experiments that achieve a successful "learning by doing" methodology [Nonaka 2000].

Clearly, this refinement and extension of the knowledge spiral model presented earlier by Nonaka and Takeuchi allows for a better understanding of the entire knowledge creation effort within an organization. In fact, the SECI process portion of this model, which is only one of the three elements included, is basically the foundation for the knowledge spiral modeled by Nonaka and Takeuchi. The other two elements are concerned with the lateral knowledge collection, transfer and, acceptance within an organization and the management of knowledge creation within an organization. Understanding the environmental and/or external factors that enhance or hinder knowledge creation within an organization is a pivotal point for this research. Although the basis of this research is measuring usable knowledge gained, the hope is that follow-on research will be able to offer recommendations that provide significant knowledge management enhancements in terms of introducing new and usable knowledge into the operating forces via DL. Basically, this model acknowledges knowledge creation within

an organization, and it also acknowledges that the knowledge creation process can be positively or negatively influenced through management.

2. Shared Context

While the SECI process relating to the knowledge spiral remains a foundational element of this knowledge creation model, this model formally recognizes the significance of the environment in which knowledge transfer occurs. The primary component of concern with the environment for knowledge transfer is the Nonaka's ***ba. Ba***, a Japanese word that roughly translates to "place", refers to the context in which the knowledge spiral occurs. Nonaka, Toyama, and Konno assert that knowledge is not a stand-alone entity but is context-specific relative to the individuals and environment interacting with said knowledge [Nonaka 2000]. Figure 7 is a visual representation of the knowledge spiral depicted in Figure 4 incorporating individual perspective and interaction with knowledge creation within a shared context, or ***ba*** [Nonaka 2000].

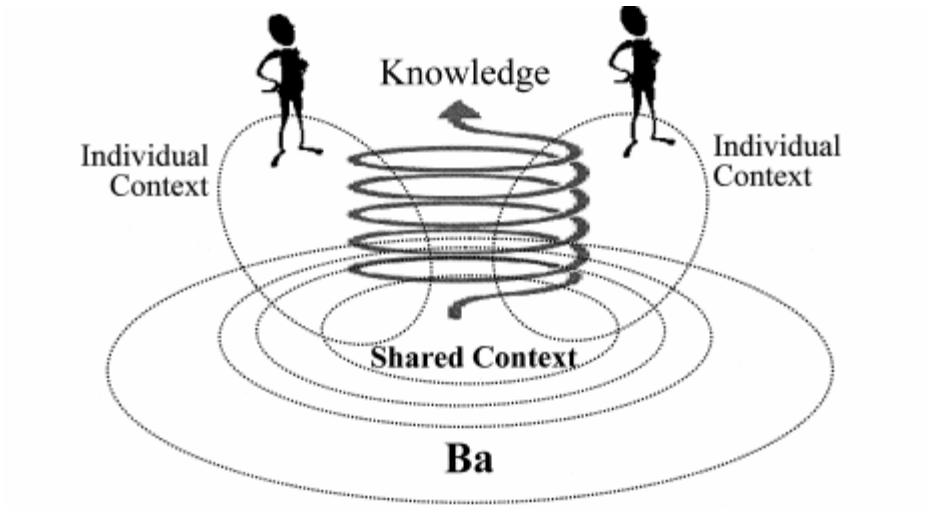


Figure 7. Knowledge Spiral with Shared Context (From Nonaka 2000)

Further developing the idea of a shared context for knowledge creations pushes towards a need for a deeper understanding of the shared context and its effects on knowledge creation.

Previous points in this research have supposed that knowledge is created within an individual; however, previous points have also hypothesized that the interaction between individuals and their immediate environment, i.e., the four modes of knowledge transfer described in the SECI process. In reality, the concept of a shared context and its

importance to knowledge creation is just an extension of and a melding of these two elements of Nonaka and Takeuchi's original model. A shared context just realizes that the interaction necessary for knowledge transfer and thus knowledge creation occurs between individuals that share a time and space that provides them a relatively shared and cohesive perspective into the application of knowledge.

One aspect that has not been addressed is the genesis of the primary research used as the basis for this research effort. Namely, Nonaka's work with various colleagues over a span of more than a decade provides the foundation for this knowledge creation literature review. Because Nonaka's work centers on the dynamics of organizational knowledge creation in Japanese industry and because many of his colleagues on sources cited in this research are of Asian decent as well, a consideration must be made of any potential bias of unique perspective on the theory of knowledge creation specifics related to cultural identity. In fact, an expectation of a difference between an Eastern and Western mindset leads to the assumption that fluctuations exist in the application of knowledge creation theory and have to be noted. "Any model which can make sense of these differences is a stronger candidate for a more general theory than those limited by behavioral and other assumptions peculiar to one or the other nation, tribe, etc." [Hedlund 1994].

Hedlund proposes an organizational knowledge creation model seen in Figure 8 similar to the Nonaka inspired models, but it is a bit more generalized and specifically recognizes the storage, transfer, and transformation of knowledge [Hedlund 1994]. Before comparing this model with the Nonaka based models, the terms he uses in his model must be defined. Hedlund's term articulated knowledge is roughly equivalent to explicit knowledge as used in the balance of this research. Articulation is tacit knowledge converting to explicit knowledge. Internalization is explicit knowledge converting to tacit knowledge. Reflection is the interaction between tacit and explicit knowledge sets. Extension is the transfer of knowledge, both tacit and explicit, from lower levels in the organization to higher levels in the organization. Appropriation is the reverse of extension and dialogue is the interaction between the two. Assimilation and dissemination are the inputs and outputs of this process [Hedlund 1994].

With terms defined, analysis of the two organizational knowledge creation models provides some insight into the possible effects of cultural perspective. Initial observation of the models shown in Figure 8 and Figure 3, inclusive of the information in Figure 5 plus Figure 6, which are considered together, demonstrate a significant amount of similarity. Both models key on the interaction between tacit and explicit knowledge bases as the foundation for organizational knowledge creation. Both models also address knowledge transfer through different levels of the organization. Hedlund's model uses the exact same naming conventions for levels of an organization used in Nonaka's knowledge original spiral, which is depicted in Figure 4.

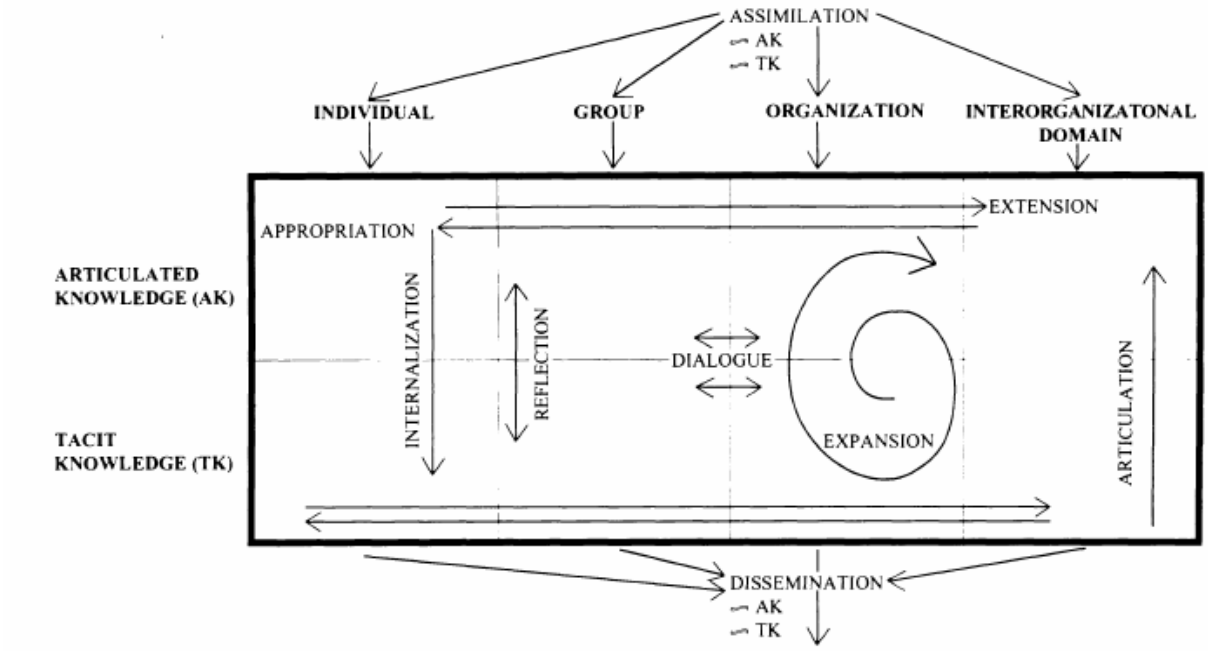


Figure 8. Hedlund's Organizational Knowledge Creation Model (From Hedlund 1994)

Interestingly, while Hedlund's model encapsulates the same essential elements as the Nonaka-based theories, it is clearly more linear in design than the Nonaka-based models, which is perhaps a bit of a nod to the Western mindset. One of the characteristics of the model that support that assertion are the pairing of arrows representing various knowledge transfers compared to the circular characteristics of the knowledge transfers in Nonaka's models. A second characteristic of the model that demonstrates linear thought is the clear delineation of inputs and outputs into the process. Another key difference between the models is the specific capture of knowledge transfers

occurring both up and down the hierarchy of an organization. Examination of these models details some differences; however, the basics of the organization knowledge creation theory of the Nonaka-based models appear in full in both models. Because the primary differences in the models do not seem attributable to the underlying theoretical concepts, the Nonaka-based theory continues to serve as the foundation for this research's literature review.

Accepting the premise and importance of a shared context for knowledge creation and acknowledgment of possible cultural differences applicable to implementation of a knowledge creating process leads to a need to understand how to prepare and facilitate that shared context in the most beneficial way in order to encourage and maximize the necessary interactions between individuals and environment required by the knowledge creation process. The first realization regarding the shared context is that the edges of that context form a barrier that is constrained by the specific task, time, current organizational competitive situation, and organizational culture. The result of this realization is that the shared context involved in the knowledge creation process is fluid and changes according to task, individuals involved, and current organization culture [Nonaka 2000].

Because the shared context element of knowledge creation serves as "melting pot" of perspectives, it follows that there are multiple means of influencing or experiencing this shared context. In fact, Nonaka, Toyama, and Konno identify four types of ***ba***: "originating ***ba***, dialoguing ***ba***, systemizing ***ba***, and exercising ***ba***, which are defined by two dimensions of interactions (see Figure 9) [Nonaka 2000]. The two dimensions considered by Nonaka, Toyama, and Konno are the type of interaction and the media through which that interaction takes place. Basically, interactions occur at the individual or related group level, and they occur either face-to-face or through a secondary means of communication.

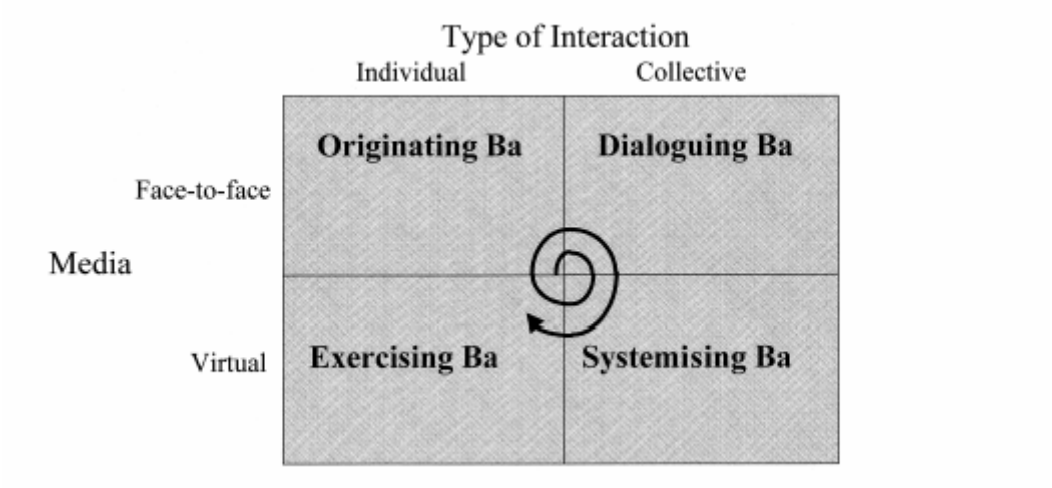


Figure 9. Types of Interaction (From Nonaka 2000)

Before a detailed examination of Nonaka's integration of the **ba,** shared context, into his knowledge creation theory, the underlying concept of how immediate environment impacts knowledge transfers in "real world" application needs to be examined. Self-reflection upon past duties and tasks in different organizations verify that there are "ways of doing business" that vary widely among similar processes depending upon the leadership-driven culture of the organization or sub-elements of the organization. In military culture, the Commanding Officer sets the command climate, which becomes the shared context for his or her staff and subordinate commanders. When a change of command occurs, it is not uncommon for the same set of staff and subordinate commanders to alter the "way they do business" to fit the new Commander's intent, (i.e., the new shared context for the organization). Usually, personnel in this situation will take the best of the old "ways of doing business" and meld it into the processes consistent with the new "way of doing business". Essentially, the organization creates new knowledge driven by the change in shared context. This phenomenon leads to the desire to identify the theoretical agent responsible for this initiation of change in shared context leading to the creation of new knowledge within the organization.

Using the scenario of a change of command develops a backdrop to review the nature of a shared context in a military setting. When a change of command occurs, the environment above the changing commander does not change, and as such, there is no expectation that the shared context influences on knowledge creation will change

significantly either. However, from the changing command on down the hierarchy of the command structure, the shared context faces potentially significant change with corresponding interactions leading to new knowledge. Furthering this point of inspection leads to seeking a connection between organization environment and knowledge creation. Matusik defines the organizational environment, or shared context, in terms of knowledge. She describes the knowledge held within an organization as private knowledge and also as a genesis of competitive advantage [Matusik 1998]. From the Matusik model presented in Figure 10 [Matusik 1998], many of the knowledge creation theory components previously discussed reappear. The unique feature of this model is the delineation between private and public knowledge. Clearly, any influence upon the private knowledge of an organization is going to subsequently influence the knowledge components of that organization. The link between shared context and knowledge creation occurs most vigorously when a command climate change is thrust upon an organization because it is during that time of change that robust interactions are forced to occur between tacit and explicit knowledge stores and between individuals and sub-elements of the organization. Inspection of Figure 10 helps visualize the relationship between a shared context and knowledge creation within an organization.

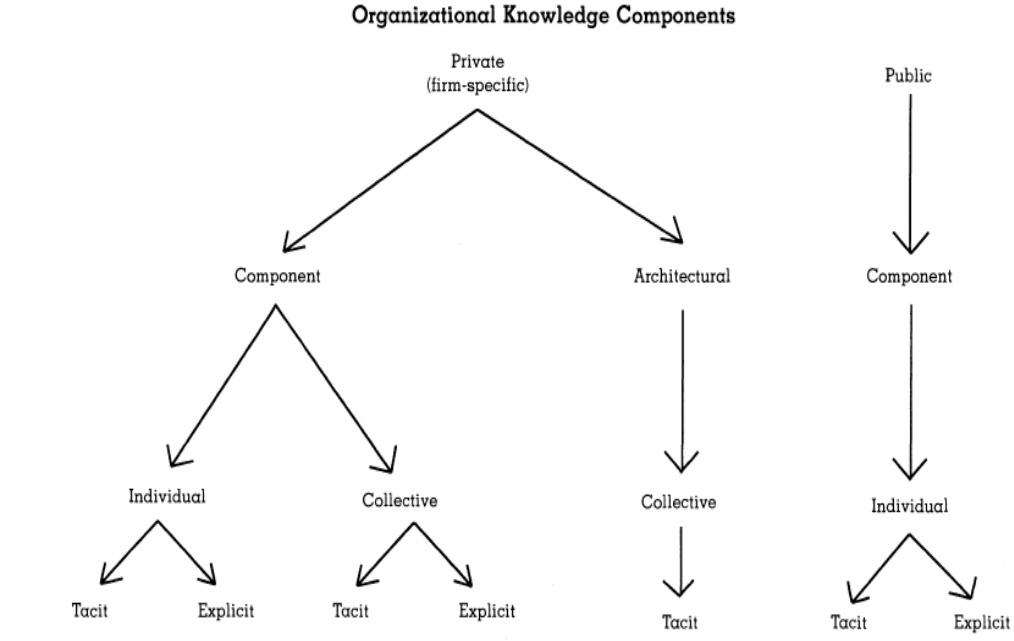


Figure 10. Organizational Knowledge Components (From Matusik 1998)

Completing a scenario based inspection of the link between shared context and knowledge creation leads to the further inspection of the theoretical components and interactions of the shared context, or **ba**. Just as in the SECI model of knowledge conversion modes depicted in Figure 1, understanding the individual types of ***ba*** is necessary in order to fully appreciate the interaction between the individual types. Again, just as in the SECI model, the interaction between the separate components is the agent responsible for supporting knowledge creation. In fact, there is a correlation between the individual modes of interaction from the SECI model and the individuals types of ***ba*** presented in Figure 9. This relationship is logical because the knowledge conversions depicted in the SECI model each lend themselves to a specific supporting context. Originating ***ba*** is defined by Nonaka, Toyama, and Konno as individual to individual interactions. This type of ***ba*** correlates to the socialization mode of knowledge conversion because face-to-face communication contains the body language aspects of communication that best augment the conveyance of tacit knowledge [Nonaka 2000]. Dialoguing ***ba*** is defined as the collective and face-to-face interactions. This type of ***ba*** correlates to the externalization mode of knowledge conversion. It is characterized by back and forth discussion and self-reflection, which is the medium best applicable to encourage tacit to explicit knowledge conversion because individually held mental models and technical skills are developed into workable concepts [Nonaka 2000]. Systemizing ***ba*** is defined by interactions that occur through multiple mediums, both collective and virtual. This type of ***ba*** correlates to the combination mode of knowledge conversion, which is essentially the conversion of explicit knowledge into more tightly defined sets or sequences of explicit knowledge assets. Systemizing ***ba*** supports this mode because of it is characterized by explicit knowledge that is easily distributed via multiple possible mediums to a large group [Nonaka 2000]. Exercising ***ba*** is defined as interactions that occur virtually and individually. This type of ***ba*** correlates to the internalization mode of knowledge conversion because it involves individuals receiving explicit knowledge via a virtual medium with the intent of adding to the individual's tacit knowledge base [Nonaka 2000].

Figure 11 is a representation of the correlation between each individual type of shared context and the mode of knowledge conversion from the SECI model that it best

supports. This correlation warrants emphasis because it draws a linear based knowledge flow connection between the Nonaka-based models and the Hedlund model, which is important to this research because it is primarily concerned with officers in the United States Armed Forces. Specifying a specific shared environment's role with a specific knowledge conversion mode develops a partial cause and effect relationship for the intended recipients of this research, which possibly provides a sense of familiarity to military officers trained in depth in sequenced processes.

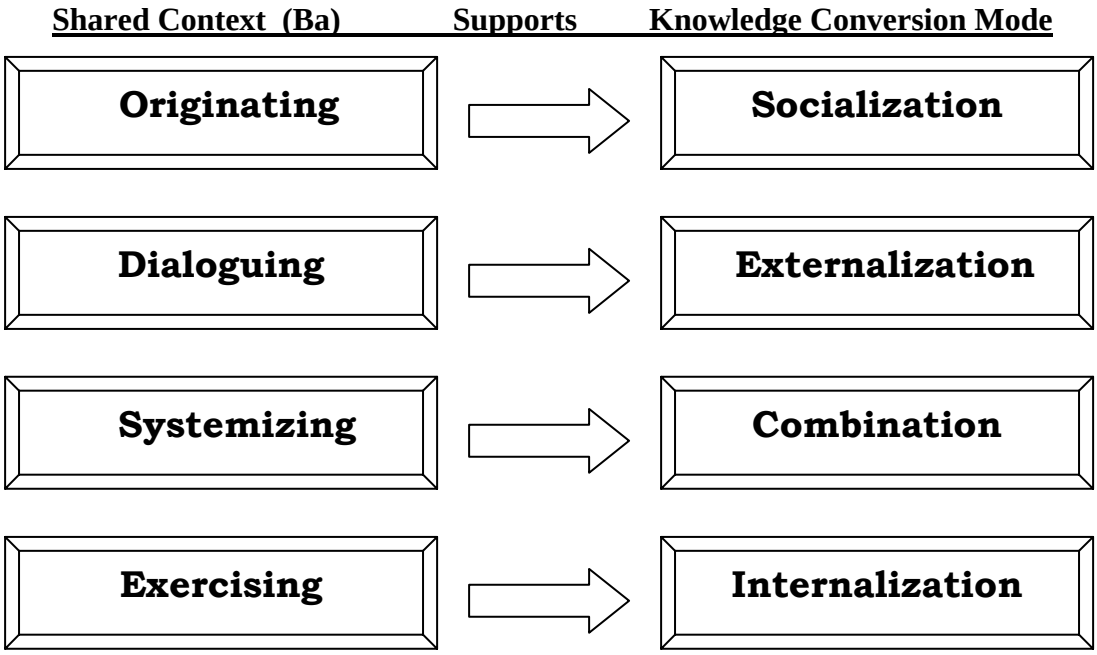


Figure 11. Relationships Between Context and Knowledge Conversion

3. Knowledge Assets

Understanding the effect of the correlation between a specific shared context and a specific mode of knowledge conversion captures a significant portion of the knowledge creation process in Nonaka, Toyama, and Konno's knowledge creation model depicted in Figure 6. The remaining element requiring consideration in an organizational knowledge creation process is the knowledge assets held by that organization. "Knowledge assets are the inputs, outputs, and moderating factors of the knowledge-creation process" [Nonaka 2000]. While this definition for knowledge assets is concrete and relatively simple conceptually, the application of knowledge assets in the knowledge creation process is where the difficulty lies. The difficulty in managing and utilizing knowledge

assets emanates from their nature. Knowledge assets are organization-specific. As such, understanding and managing those assets demand continual focus within the organization, and that management cannot be applied through a generic "book answer" type of approach. Additionally, because knowledge assets are organization specific, in a military organization those assets are prone to a high level of fluctuation due to the transitory nature of personnel in key positions. Beyond the fluidity associated with knowledge assets, they are extremely dynamic and somewhat evolutionary in themselves because they consist in large part of inputs and outputs of an organization's knowledge creation efforts [Nonaka 2000].

Nonaka, Toyama, and Konno identified four categories of knowledge assets. Their four categories of knowledge assets are experimental knowledge assets, conceptual knowledge assets, systemic knowledge assets, and routine knowledge assets. Not surprisingly, the categories of knowledge assets "fit" onto the updated SECI model and the types of ***ba*** model. This symmetry of models is obvious from the knowledge assets categorization model presented by Nonaka, Toyama, and Konno as depicted in Figure 12 [Nonaka 2000].

Prior to working through the concepts of knowledge assets in detail, observation of Figure 12 identifies the absence of a specific reference to the "lifelong" tacit base of knowledge held by individuals in favor of the individual tacit knowledge base relating to specific skill sets and processes. Surely, an individual that has years of experience that has been augmented with both formal and informal training and education possesses a substantial capability to enhance knowledge flows within an organization, even if specific tacit knowledge related to relevant organizational processes is immature. Basically, since people are an asset to an organization, the tacit knowledge bases built by those individuals prior to joining the organization are knowledge assets the organization can exploit and use just by the default of employing that individual. The concept of careers as a knowledge repository of all of the skills ever used and developed by and individual vice just a sequence of jobs supports the concept of a "lifelong" tacit knowledge base at the individual level as a knowledge asset for gaining organizations [Bird 1994].

Experiential Knowledge Assets	Conceptual Knowledge Assets
Tacit knowledge shared through common experiences • Skills and know-how of individuals • Care, love, trust, and security • Energy, passion, and tension	Explicit knowledge articulated through images, symbols, and language • Product concepts • Design • Brand equity
Routine Knowledge Assets	**Systemic Knowledge Assets**
Tacit knowledge routinised and embedded in actions and practices • Know-how in daily operations • Organisational routines • Organisational culture	Systemised and packaged explicit knowledge • Documents, specifications, manuals • Database • Patents and licenses

Figure 12. Knowledge Assets Categorization Model (From Nonaka 2000)

Exploring the knowledge assets as presented in the Nonaka-based model begins with experiential knowledge assets. Experiential knowledge assets, the tacit knowledge acquired through shared experiences/environment within an organization, span the spectrum from emotional to skill specific elements of an organizational tacit knowledge base. Because this type of knowledge asset relies upon common experience, it is organization specific and can only be developed or acquired through an organization's experiences resulting from pursuit of mission objectives and the processes employed to meet those respective mission objectives [Nonaka 2000]. Because an organization's experiential knowledge assets reside in a tacit form, a recognizable association emerges with the originating type of shared context and the socialization mode of knowledge conversion.

Conceptual knowledge assets exist in explicit form. Nonaka, Toyama, and Konno define these assets as "explicit knowledge articulated through images, symbols, and language" [Nonaka 2000]. Because conceptual knowledge assets are explicit in nature, an assumption holds that the initial level of understanding of these assets is higher than the other forms of knowledge assets. A key characteristic of conceptual knowledge assets is that they are not necessarily tightly codified or specifically anchored to a process or system, even though they are explicit in nature. Because of their explicit nature and

their “high level” characteristic, conceptual knowledge assets seem to have an association with the dialoguing type of shared context and the externalization mode of knowledge conversion.

Systemic knowledge assets consist of formalized explicit knowledge that directly supports a process or system. “A characteristic of systemic knowledge assets is that they can be transferred easily” [Nonaka 2000]. Systemic knowledge assets differ from the explicit knowledge assets that are classified as conceptual knowledge assets in that systemic knowledge assets are highly codified and associated with specific processes. Recalling that knowledge assets function as inputs and outputs and potentially demonstrate an evolutionary nature helps define systemic knowledge assets. For example, documentation for a process is a systemic knowledge asset for an organization. Using that documentation as an input into the greater knowledge creating processes of an organization may result in an output from that greater knowledge creating process of a refined or updated process, which then in turn results in an output of refined or updated documentation. This example demonstrates the explicit to explicit knowledge conversion that occurs in the combination knowledge conversion mode, which is supported by the systemizing shared context.

Routine knowledge assets are exactly what their name suggests. They are tacit knowledge assets ingrained into routine process and actions within an organization. Because routine knowledge assets are nurtured “on the floor”, they have the distinction of being highly specific and workable bits of knowledge. Essentially, routine knowledge assets are practical [Nonaka 2000]. Additionally, routine knowledge assets become so much a part of the individuals and processes “on the floor” that they can be dismissed as “just the way things are done”. However, because routine knowledge is applied at the production or tactical application level, it has in many ways the potential to induce the most immediate and noticeable results in the knowledge creating endeavors for an organization. Because instruction in a daily activity is explicit but exercising that instruction taps into the tacit knowledge held in a process and builds the tacit base of the individual, routine knowledge assets roughly correlate with the exercising shared context and the internalization mode of knowledge conversion.

One key element not detailed explicitly in this model is the role of the different layers of management in the knowledge creation process; however, the role of management in the knowledge creation process is a foundational element for Nonaka's model. Nonaka highlights the responsibilities of management and their critical role in the knowledge creation process in context of the SECI knowledge creation model with the following: "the key to leading the knowledge creation process is dialectical thinking. The role of top management in articulating the organization's knowledge vision is emphasized, as is the important role of middle management ('knowledge producers') in energizing *ba*." [Nonaka 2000]. Recognizing that knowledge management is essential and that knowledge creation occurs and requires management begins at the top levels of management. Without the blessing from the top, the required focus and required assets will not be available for the "knowledge producers" to positively influence the process. Once top management sets a knowledge creation and knowledge management vision for an organization, the responsibility for the execution of that vision falls to middle and low-level management as well as to the individuals that work in that organization. Middle and low-level management assumes the responsibility to first, make an effort to recognize and identify opportunities to 'fertilize" the knowledge sharing environment between personnel and processes within their purview, second, actively encourage the interaction of knowledge aspects, and third, emphasize the importance of knowledge creation and transfer to all personnel to include positive reinforcement for employee contributions in this area. The last point brings forward the necessity to educate, motivate, and outfit individuals within the organization in order to foster a knowledge creating environment, because new knowledge creation has its genesis at the individual level. While knowledge creation requires sponsorship from the top, it thrives through the "buying in" from the bottom coupled with active nurturing in the middle.

Focusing on the management of the knowledge creation process leads to examining the knowledge creation environment closely. When the knowledge spiral was the model basis for knowledge creation understanding, the knowledge creation environment was understood to important but was explained almost superficially. A measured perspective on the managerial environment that exists where knowledge creation occurs for an organization projects multiple contradicting forces upon the

process. Expanding upon Figure 2, Inkpen and Dinur's knowledge transfer classification framework, allows for examination of different knowledge management processes. Their underlying assumption is that because different knowledge transfers occur at different levels of the organization, knowledge management processes applied relative to the target transfer may provide better results than a less discriminating approach of matching management process to knowledge transfer or conversion. Based upon a collection of case studies of American firms engaged in joint ventures, Inkpen and Dinur "examined the processes used by firms to gain access to and transfer different types of alliance-based knowledge" [Inkpen 1998]. Figure 13 captures the essence of their results in correlating knowledge types and organizational levels [Inkpen 1998]. The first step in extracting the pertinent information from illustration is defining the terms and symbols used by Inkpen and Dinur in Figure 13 that are not universal enough to dispel any ambiguity. Conscious knowledge is primarily tacit in nature and individually held. Collective knowledge is primarily tacit; however, it is tacit knowledge that has become part of the organization's tacit knowledge base. Objectified knowledge is primarily explicit and resides at the organizational level. JV-Parent Interaction refers to the relationship permitting knowledge transfers between the United States-based firms and the Japanese companies united through a joint business venture. Strategic Integration is the exchange of organizational culture and explicit knowledge sources between the joint venture partners in the case studies. Technology sharing knowledge is almost exclusively explicit in nature because it refers to information such as product design or specific process data in the Inkpen and Dinur study.

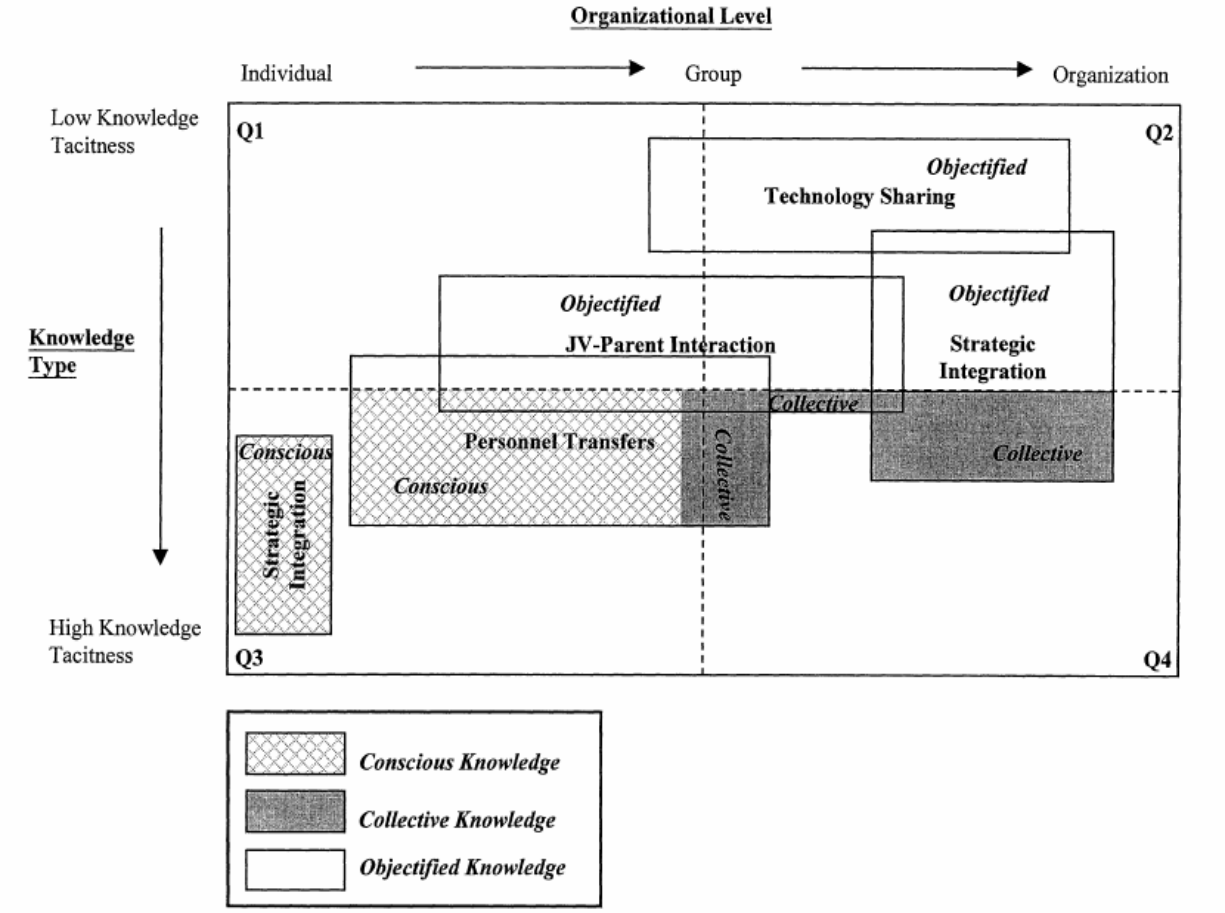


Figure 13. Knowledge Transfer Classification Network (From Inkpen 1998)

The study referenced in Figure 13 provides a "real world" example of knowledge transfers that allow for expanding the theoretical knowledge base through a measure of reflection. A key point to consider is that the Inkpen and Dinur study focused on specific knowledge transfers within the confines of specific business ventures; therefore, their results may or may not follow the theoretical characteristics of organizational knowledge creation as put forth by the Nonaka research. Examining Figure 13 provides similarities and differences between the Inkpen and Dinur results compare against the Nonaka-based organizational knowledge creation theory.

A starting point for comparing the results to theory is the overlap in the boxes representing knowledge transfers on Figure 13, which roughly translates to the interaction between knowledge-conversion modes in Nonaka's knowledge spiral. The theoretical expectation is that these overlaps are where the bulk of the knowledge creation occurs as

knowledge spirals up from the personal level to the organizational level. A foundational supposition for knowledge creation is that individual knowledge is a primary seed for organizational knowledge creation. However, "based upon their findings, Inkpen and Dinur conclude that only a limited amount of knowledge associated with personnel transfers "spiraled" beyond the group level to the organizational level" [Inkpen 1998].

Perhaps an explanation for the lack of personnel knowledge spiraling up to the organizational level in the Inkpen and Dinur study can be attributed to the differences in the organizational cultures of the Japanese and American firms associated in the joint venture environment, which indicates the impact of ba upon the knowledge creation process. Inkpen and Dinur speculate that a more robust transfer of tacit knowledge at the organizational level was possible but not achieved. "Resistance in the American parents to the cost of learning limited the effectiveness of the process at the organizational level" [Inkpen 1998]. While this lack of knowledge spiral generated from the tacit knowledge held by individuals in an organization seems to contradict the Nonaka-based theory of organizational knowledge creation, noting the date of the Inkpen and Dinur study helps establish a better theoretical context for analysis of this point. The Inkpen and Dinur study does present findings that deviate from Nonaka based theory. However, they do discuss the effects of having two different cultures involved in the case studies and hint at the effect of that relationship on the organizational knowledge transfer and creation that resulted from those interactions. In effect, Inkpen and Dinur's findings become much more consistent with Nonaka-based theory when analysis is expanded to include the importance of shared context, or ***ba,*** which was not published theory by Nonaka, Toyama, and Konno until 2000. Considering a breakdown or divide in the shared context perceived by the Japanese and American firms in the case studies presents some reasonable explanation as to why the "knowledge spiral" did not progress more in accordance with the organizational knowledge creation theories based upon the works of Nonaka and his associates.

At the heart of the knowledge creation process, the SECI process is the interaction between the two defined poles of knowledge, i.e., tacit and explicit. This distinction further applies in the intended environment of this research: projecting knowledge creation onto an organization that traditionally relies upon regimentation and "machine-

like" processes. One way this interaction occurs is with the application of graduate education via DL while working in an operational billet, which routinely introduces unforeseen obstacles for the person and organization attempting to introduce new knowledge in explicit form into the knowledge creation process for the organization. Beyond the natural friction of these interactions caused by the contradictory nature of the forces involved is the almost tangible resistance to process and system inputs that do not demonstrate an intuitive increase in measurable production. For a mission-oriented organization, like a branch of the United States Armed Forces, these real concerns and interactions provide enough friction to possibly lead to a less than fully committed pursuit of the knowledge creation process by multiple levels of the organization. A breakdown in commitment anywhere in the management of the process cripples the potential of the process as the SECI model clearly demonstrates; therefore, understanding and managing the inherent contradictions in the knowledge creation environment is the key to success. Figure 14 depicts the knowledge spiral's interaction with opposite or contradicting forces [Nonaka 2000].

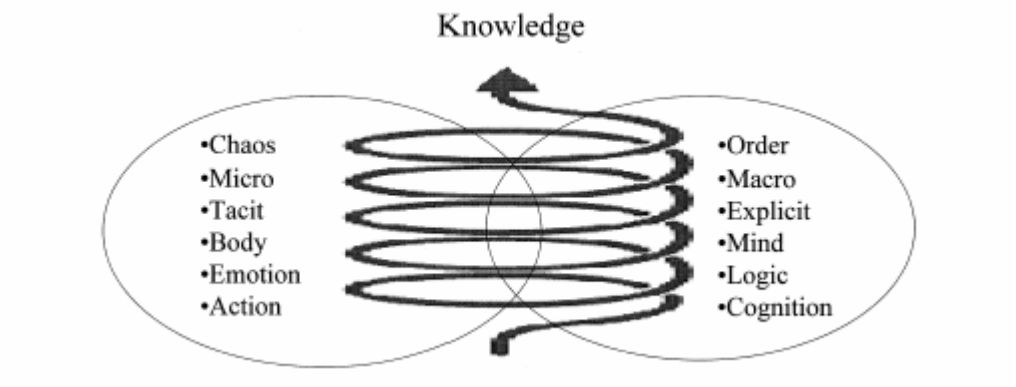


Figure 14. Knowledge Spiral with Contradicting Forces (Nonaka 2000)

4. Management and Leadership

Nonaka, Toyama, and Konno argue that the cornerstone for effective management of the knowledge creation process is dialectical thinking, which captures the potential synergy of the inherent contradiction and transcends them [Nonaka 2000]. Upon further consideration, the opposing or contradictory element of managing the knowledge creation process was stated without complete realization in the original Nonaka and Takeuchi model. This element of the process has always been there because it was the interaction

between tacit and explicit knowledge that was identified as the key element of knowledge creation in the initial model. Extrapolating this interaction to include all contradictory influence in the knowledge creation process augments the arguments put forth by Nonaka, Toyama, and Konno as to the importance of the dialectical element of knowledge management and leading for an organization.

Discussion of managing the knowledge creation process for an organization highlight the total integration required from all levels of management necessary to succeed. Beyond management, the individuals, who are the primary means of the raw knowledge inputs into the knowledge creating process; have to be fully invested in the process as well. Nonaka, Toyama, and Konno specifically highlight the role of middle management as being vitally important to the success of any knowledge creation effort by an organization. "Especially crucial to this process is the role of the knowledge producers, that is, the middle managers who are at the intersection of the vertical and horizontal flows of information in the company and actively interact with the others to create knowledge by participating in and leading ***ba***" [Nonaka 2000]. The pivotal role of the middle manager makes sense because the knowledge creation process is by no means linear, so the best position to influence the process is the one of greatest intersection of system feedback loops. Because middle management generally functions at those intersections, it is in the best position to lead the complex process of organizational knowledge creation. Figure 15 is Nonaka, Toyama, and Konno's representation of the leadership relationship with the knowledge creation process and depicts the many feedback loops plus inputs and outputs involved [Nonaka 2000].

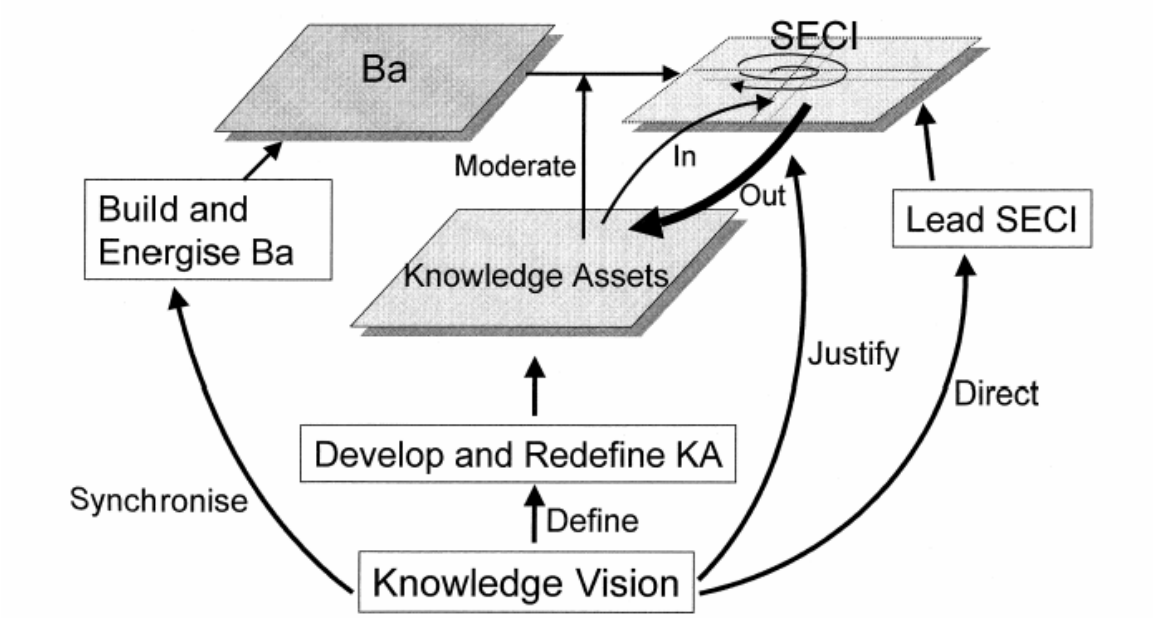


Figure 15. Leadership's Relationship with Knowledge Creation (From Nonaka 2000)

While Figure 15 depicts leadership's role in the organizational knowledge creation process, it does not make a relative linkage between management's role in organizational knowledge creation and active knowledge management as a pursuit of the organization. In fact, knowledge management as a managerial discipline is a separate but related function. For this research, knowledge management is defined as a managerial perspective that seeks to identify knowledge flows within an organization and then proactively manage those knowledge flows for the most organizational benefit. Figure 15 is a knowledge management model that captures the relationship between knowledge flows and the enablers, i.e., "Culture, Infrastructure, and Technology – each active at all stages of knowledge flow" [Armbrecht 2001].

Interestingly, while the knowledge management model and the knowledge creation models do not model the same process, there are many parallels between them. The idea of knowledge sources, both tacit and explicit, providing the impetus for knowledge flows through an organization appears in both model types. The knowledge management "enablers" provide the shared context detailed in Nonaka-based models as ***ba***. The Strategy and Goals block in Figure 16 correlates to the Knowledge Vision block presented in Figure 15. Reading the amplifying information presented in support of both model types does raise and emphasizes the differences in scope and focus of these

models. However, understanding the Nonaka-based knowledge creation models provides a foundation for understanding the knowledge management models. The parallels described lead to the assertion that effective organization knowledge management relies upon an understanding of the knowledge creation process for an organization

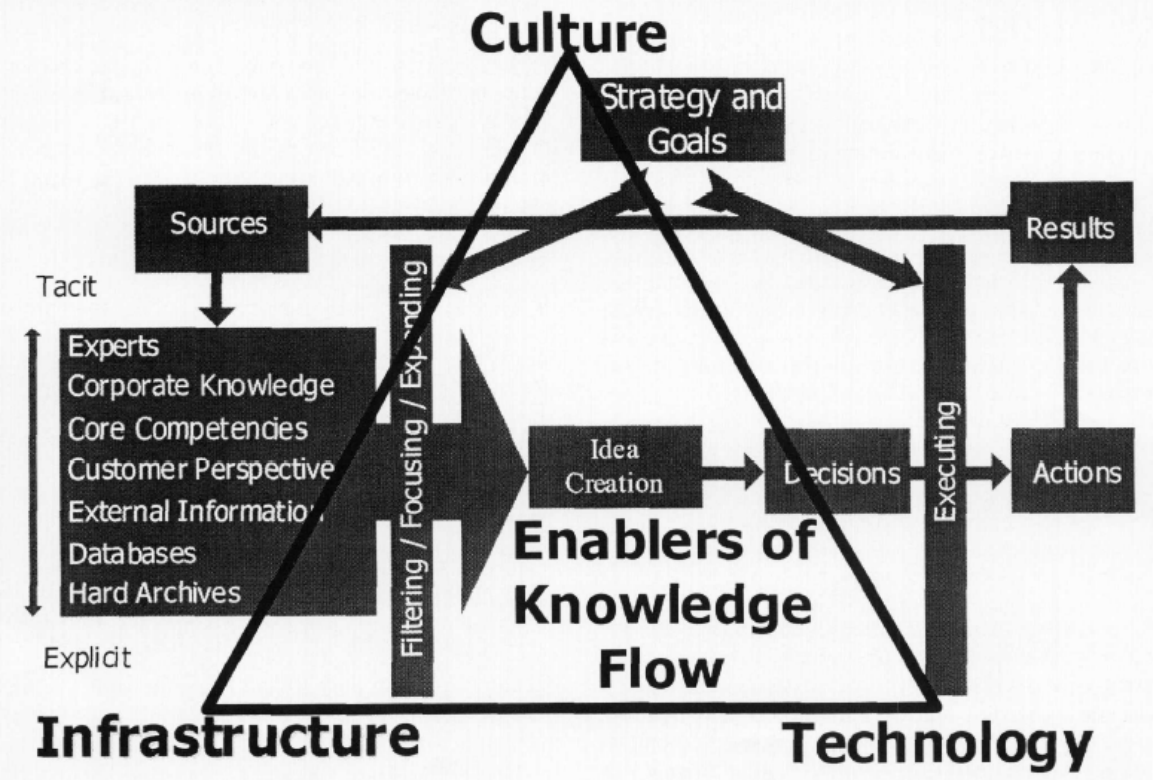


Figure 16. Knowledge Flows and Enablers (From Armbrecht 2001)

A literature review of knowledge creation theory was central to the primary and supporting research questions of this research. It provided the base of knowledge necessary to conduct the data collection and data analysis portions of this research. Additionally, refining the scope of this literature review led to the development of the hypothesis curve.

III. RESEARCH QUESTIONS AND HYPOTHESIS

A. PRIMARY RESEARCH QUESTION

- Is NPS DL coursework comparable to resident coursework in terms of usable knowledge gained?

B. SUPPORT RESEARCH QUESTIONS

- Does NPS effectively and quickly distribute graduate – level skills via DL to the personnel serving in the operational billets?
- Is there any transfer of knowledge from a DL student to their organization?
- Can frequency of use of skills learned through DL be used as a measure of effectiveness for the DL program at NPS?

C. RESEARCH METHODOLOGY

Data gathering was accomplished through literature review, survey of DL students, and interviews. Review of literature comprised a significant portion of the research due to the large amount of data available relating to the research questions. The NPS DL program was the primary focus of this research because it makes graduate level education available to all branches of service via a DL program, which makes this institution a uniquely centralized platform for study of the primary research question. Data gathered through survey of NPS DL students was evaluated to draw conclusions about the effectiveness of the NPS DL program in providing usable, relevant knowledge to personnel serving in the operating forces.

D. FRAMEWORK FOR BUILDING HYPOTHESIS

Because the primary data collection tool is a survey given to active duty military personnel serving in the operating forces that have completed DL courses, responses

from that survey present an "end product" of knowledge gained through DL coursework from NPS. However, addressing the research questions demands a "prior state" or condition to compare with the "end product" to draw results and conclusions. Due to the unique nature of service in operating billets, i.e., rapid rotation of personnel through billets and commands coupled with a time constraint of approximately one year for this specific research effort, a "prior state" cannot be accurately measured in the response pool for the survey. Because a "prior state" cannot be accurately measured, a hypothesis of expected results from the data collected from the survey is necessary; this was accomplished via literature review.

A suitable hypothesis for this research is an expected "knowledge gained" curve. A literature review that builds an expected knowledge gained curve must address a starting point at time zero, depict a rate of knowledge acquisition, a peak of usable knowledge gained, and an acknowledgement of knowledge decay. While an expected "knowledge gained" curve serves well as a hypothesis, it does not address all of the specific considerations required for the research questions.

The literature review must also address the possibly unique effects of the personnel pool being surveyed and their environment during the learning process. The DL students being surveyed all are military members serving in the operational forces. These students are taking DL courses while serving in demanding billets with considerable responsibility. Additionally, the expectation is that the student pool is remarkably homogenous in education, motivation, and experience as compared to the general public due to the nature of their military officer demographic.

1. Literature Review for Hypothesis Curve

Prior to determining the amount of usable knowledge gained from a course or courses via any format or platform, a working definition of knowledge is required. Since this research aims to draw conclusions about knowledge gained through DL coursework by individuals serving in operational billets, this definition must include past and present experiences of the gaining individuals. Housel and Bell offer a useful definition of knowledge as a starting point for their work in *Measuring and Managing Knowledge*. "Knowledge is an ideational (i.e., conceptual rather than physical) construct generated through the agency of the human mind." [Housel 2001]. While knowledge is generated

in the human mind, an important consideration is that it is created via information flow that is filtered and built on the individual's belief system [Nonaka 1994]. Beyond the broad, working definition of knowledge presented, knowledge can be categorized further to better represent the human encapsulation of knowledge. Knowledge is described as either tacit or explicit by convention. From an education research perspective, "tacit knowledge is subjective, context-specific and not readily communicated other than by demonstration. Explicit knowledge is objective, generally applicable and capable of being described in systematic, propositional language." [Hegarty 2000]. In general, for this research effort, explicit knowledge is gained through a more formal, classroom type environment, while tacit knowledge is gained through a more "hands-on" approach. Assuming that both explicit and tactical knowledge reinforce each other resulting in an effect of "the whole being greater than the sum of its parts" and that knowledge creation is a human endeavor influence by environment, the working definition of knowledge for this research is defined as the gathering and internalizing of relevant information through formal and informal means by an individual. Usable knowledge is defined for this research as knowledge applied directly or indirectly by an individual in the individual's primary area of responsibility.

a. Estimate of Knowledge at Time Zero on Hypothesis Curve

With a working definition established for knowledge and usable knowledge in context of this research, the starting point for building a hypothesis consisting of an expected "knowledge-gained curve" is an estimation of knowledge at time zero. Intuitively, an individual's knowledge at time zero is greater than zero. Clearly, an officer serving in an operational billet has some knowledge of his or her area of responsibility. A servicemember begins building a repository of tacit knowledge upon assumption of a billet just by virtue of performing that billet. Additionally, at a minimum, that servicemember likely has access to codified knowledge regarding policies and procedures relating to his or her current billet. Making a finite judgment on the amount of tacit knowledge held by one individual is not possible with any level of certainty due to the nature of that classification of knowledge. While specifying a level of tacit knowledge is not practical, tacit knowledge can be characterized. "Research has shown that tacit knowledge generally (a) increases with experience on the job, (b) is

unrelated to IQ, (c) predicts job performance better than IQ, (d) provides a significant increment in prediction above that provided by traditional tests of intelligence, personality, and cognitive style, and (e) overlaps across fields, though only partially" [Sternberg 1995]. From this characterization, an expectation exists that the tacit knowledge held by an individual prior to taking a DL course will vary with the billet held, time in that billet, and previous experience. Assuming that the knowledge gained from a DL course will primarily be explicit knowledge that will rest on top of the individual's existing base of tacit knowledge leads to an expectation that the individual's expected "knowledge-gained" curve will start at the current level of tacit knowledge and increase as explicit knowledge is learned.

b. Positive Slope Characteristics of the Hypothesis Curve

Establishing knowledge at time zero on an expected "knowledge-gained" curve as the sum of the tacit knowledge held by an individual, resident in the billet's processes, and the explicit knowledge available to the individual in relation to the billet held develops a starting point for usable knowledge that is logically more than zero, less than some maximal value attainable, and varies from individual to individual. Adding knowledge through DL courses increases the total knowledge available to the individual at time zero and creates a situation where the expectation is an increase in knowledge of the individual beyond the knowledge level at time zero, which would be represented by a positive slope on the expected "knowledge-gained" curve from the starting point at time zero to some maximum knowledge value attained at some time in the future. Because the knowledge exposure through DL coursework is primarily explicit in nature, the increase in knowledge of the individual really is a question of how explicit knowledge interacts with the tacit knowledge held by the individual.

2. Application of Explicit and Tacit Knowledge Interaction

Examining how tacit and explicit knowledge interact begins with Nonaka and Takeuchi's work in *The Knowledge Creating Company*. Their "knowledge spiral" model "identifies four inter-related processes by which knowledge flows around an organization and transmutes into different forms" as cited by Thomas Clarke and Christine Rollo [Clarke 2001]. While the Nonaka and Takeuchi model provides a means of understanding how knowledge is created, it is a model based upon industry, processes,

and organizations. This research, on the other hand, is primarily interested in knowledge creation and management at the individual level and in an environment that does not have the same competitive pressures or concerns as commercial industry. However, the base assertion of the model that tacit and explicit knowledge interact in a variety of ways to create new knowledge becomes the cornerstone of this research's effort to quantify how much usable knowledge is gained by servicemembers in the operating forces through DL courses.

The differences in environment and scope for this research and the intended audience for the Nonaka and Takeuchi model helps establish a bridge between the industrial and educational application of their model as a necessity for using their model to describe knowledge creation in context of this research. The key to establishing that bridge is defining how new knowledge is captured in a professional environment. David Hargreaves writes, "After knowledge has been created, it needs to be validated. In professional life, knowledge achieves validation when it is turned into practices which demonstrably and repeatedly work" [Hargreaves 1999]. If the process of refining practices in search of a collection of best practices in a business environment is substituted for the organizational processes inherent to the Nonaka and Takeuchi model, that model begins to have more usefulness for this research in terms of modeling and describing the creation and transfer of usable knowledge via the DL program. Additionally, Hargreaves assertion that new knowledge is validated in practice lends itself to using frequency of use as a metric for measuring usable knowledge transfer.

a. Apex Characteristics of the Hypothesis Curve

Building an argument for applying the Nonaka and Takeuchi model of knowledge creation as an applicable model, acknowledging concessions for this research in terms of knowledge creation limited to the individual and environment of those individuals provides the background necessary for describing the apex of the expected "knowledge-gained" curve. Nonaka acknowledges the transfer between explicit and tacit knowledge in an individual with the following: "In order to raise the total quality of an individual's knowledge, the enhancement of tacit knowledge has to be subjected to a continual interplay with the evolution of relevant aspects of explicit knowledge" [Nonaka 1994]. The expectation that explicit knowledge garnered through DL work will add to

the individuals' existing tacit knowledge to create a positive increase in individual knowledge is also described in part by the Internalization component of the Nonaka and Takeuchi model, which models explicit knowledge conversion into tacit knowledge. Individuals can internalize explicit knowledge to further their reservoir of tacit knowledge [Nonaka 2000]. Borghoff furthers this assertion by claiming that actual new tacit knowledge can be created through internalizing explicit knowledge [Borghoff 1997]. Describing the apex of the expected "knowledge-gained' curve centers on the interaction between an individual's tacit and explicit knowledge. Since the realization of new tacit knowledge at the individual level does not occur until explicit knowledge has been internalized, the introduction of new explicit knowledge will only increase an individual's level of tacit knowledge if it is internalized. Because tacit knowledge is the knowledge of doing and experience, the internalization process occurs primarily in the practical application of the new explicit knowledge. It follows that the maximum practical use of new skills corresponds to the maximum internalization or conversion of newly acquires explicit knowledge into the individual's base of tacit knowledge. This assertion leads to the expectation that the apex of the expected "knowledge-gained" curve will correlate with the maximum frequency of use of the new explicit skills, resulting in the maximum amount of new total knowledge for the individual.

b. Negative Slope Characteristics of the Hypothesis Curve

Accepting the description that the apex of the expected "knowledge-gained" curve occurs at the point of maximum new explicit knowledge "added" to the individual's existing base of tacit knowledge, a negative slope along the "knowledge-gained" curve beyond the apex is expected. This research asserts that this negative slope, which represents a reduction in individual knowledge, results from knowledge decay and from conversion of explicit knowledge gained from DL work into the tacit knowledge base of the individual. In general, knowledge decay results from non use of knowledge sets over time. Kipps, Kohen, and Paden, citing a study of knowledge decay in a group of economic students over various time periods, find an inverse and nonlinear relationship between the levels of knowledge retained at a time zero and at some time in the future [Kipps 1984]. The existence of knowledge decay over time is relatively easy to accept as a real phenomenon by any student who has ever taken a course that does not

directly contribute to skills necessary in the day-to-day execution of their job. The rate of knowledge decay is a matter that is influenced by a number of factors, such as the initial scholastic ability of the student and dedicated efforts over time to reinforce knowledge gained [Kipps 1984]. An inference from this study applies to this research because the assumption is that DL students will take courses that enhance specific skill sets applied in the routine execution of their billets. This inference leads to an expectation of a reduced rate of knowledge decay in this population, which should be visible in the frequency of use of those skills reported. Describing the negative slope of the "knowledge-gained" curve also includes the factor of conversion of new explicit knowledge to tacit knowledge. Taken from Nonaka and Takeuchi's model, internalization, which is conversion of explicit to tacit knowledge, is the mode of knowledge creation that captures this conversion. For an individual, the interaction between tacit and explicit knowledge is an enabler to enhancing the individual level of experience and perspective [Nonaka 1994]. This interaction is in reality just increasing the individual's level of tacit knowledge in an area of expertise, because experience and perspective are central elements of an individual's tacit knowledge base. For an expected "knowledge-gained" curve, this conversion of explicit knowledge to tacit knowledge will probably appear as a decrease in knowledge from the apex of the curve. As the usable knowledge gained is implemented repeatedly over time, that knowledge becomes more "intuitive" for the individual and will probably be used less consciously as that new knowledge is internalized. Because frequency of use is the metric used to draw the usable "knowledge-gained" curve from the survey results, this internalization aspect of the knowledge gained will drive the hypothesis curve to a negative slope beyond the apex of the curve. The final component of an expected "knowledge-gained" curve is the end point. Since the start of the curve at time zero is the individual's tacit knowledge base and explicit knowledge is added, the internalization of that added explicit knowledge is expected to result in a higher level of individual tacit knowledge.

3. Hypothesis Curve Characteristics

From the previous literature review, the points used to construct a generalized hypothesis curve are as follows:

- knowledge level at time zero is the individual's existing tacit knowledge base (e.g., four years of college + service schools + service experience, etc.)
- positive slope of curve represents the addition of relevant explicit knowledge
- apex of curve is defined as the maximum input of explicit knowledge prior to decay or internalization
- negative slope of curve represents decay and internalization
- end point of curve is higher than start point at time zero to reflect the usable knowledge gained
- Time (T) is in months - 36 months represents a typical tour length

The generalized expected "knowledge-gained" curve is in Figure 17.

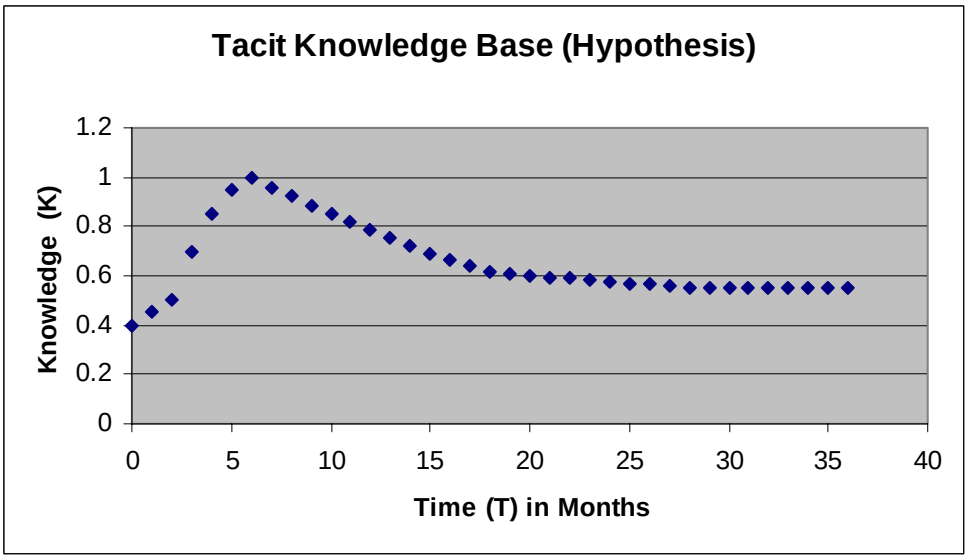


Figure 17. Tacit Knowledge Base (Hypothesis Curve)

IV. DATA COLLECTION

This chapter details the collection method used to gather data for analysis regarding the four research questions addressed in this study. The data collection methodology, population, objectives, and design are explained.

A. DATA COLLECTION POPULATION

1. Distributed Learning Students

This research is concerned with the level of usable knowledge gained or refined through NPS DL coursework by individuals serving in the operating forces. Due to the student demographic required for this data collection, the first step in the process was identifying the student population for study. This research focuses on students that are currently enrolled or have completed all or part of the four classes in the Information Systems and Operations (ISO) Certificate Program offered through NPS DL. This certificate program was chosen because it is a mature program, which has over two hundred students that are current or past students. Additionally, this program focuses study in the Information Sciences discipline, which is of personal interest to the researcher.

2. ISO Certificate Program

The ISO Certificate Program is a stand alone certificate program but is also serves as the first phase of the Naval Postgraduate School Master of Science degree in Information Systems and Operations [NPS 2006]. The ISO Certificate Program consists of the following four courses:

- SS3011 - Space Technology and Applications
- IO3100- Information Operations
- IS3502 - Computer Networks: Wide Area/Local Area (Intro to Information Systems Networks)
- CC3000 - Intro to Command , Control, Communication, Computer and Intelligence Systems in DoD

Individual course descriptions provide a higher level of insight into the scope of the ISO Certificate Program. Individual course descriptions accessible through the ISO Certificate Program webpage follow:

SS3011 - Space Technology and Applications

An introduction to space mission analysis with an emphasis on those space missions supporting military operations. Topics include space history, doctrine and organizations, orbital mechanics, communication line analysis, space environment, spacecraft technology, and military, civil and commercial space systems [NPS 2006].

IO3100 - Information Operations

This course provides a survey of Information Operations (IO) along the time line of peace, to conflict, and back to cessation of hostilities. Students study the methods and elements which contribute to successful Information Operations including: Psychological operations and deception, Operational security, information assurance, and infrastructure protection, Electronic attack/protect/support, Physical attack/destruction in support of IO, Military-civilian relationship, Human cognition and decision making, Command and control structures, Legal issues, Computer and network attack, Systems engineering concepts (including modeling and simulation), Sensor and signals intelligence support to IO [NPS 2006].

IS3502 - Computer Networks: Wide Area/Local Area

Architecture, standard protocols, and technological advances in computer networks, with an emphasis on internet working and interoperability. Specific topics include open network architectures (OSI vs. DoD architecture), X.25, local area networks, TCP/IP, and a variety of distributed application services built on the client-server model. Students also gain an understanding of Network Centric Warfare requirements surrounding DDN (Defense Data Network), X.400-based DMS (Defense Message System), SDNS (Secure Data Network Service), and GOSIP (Government Open System Interconnection Profile) [NPS 2006].

CC3000 - Intro to Command, Control, Communication, Computer and Intelligence

Systems in DoD Knowledge of current C4I systems and practice is introduced. A basic framework for understanding C4I is provided. Case studies are used as well as lessons learned from crises, field exercises and wargaming [NPS 2006].

B. DATA COLLECTION DESIGN

Because the primary data collection tool for this research is a survey, the design of that survey required planning to ensure reliable data collection. The primary concern was designing questions that elicited responses directly related to the four research questions in this study. After drafting questions for these areas of interest, the survey required six iterations of review in order to scrub leading or ambiguous questions. The desire was to eliminate as much of the potential for respondent bias or confusion as possible.

1. Initial Survey Design

The survey design process began with a previous set of questions from a survey developed for the ISO program students. This survey was primarily generated to capture a mix of student demographic information along with student perceptions regarding the training/education mix and delivery of graduate education via DL in the ISO program. The version of the initial questions employed in the final survey is presented in Table 1. The choices of answers were checkboxes, radio buttons, and rating tables, respectively.

No.	Question
1	Check each course below taken through DL with NPS.
2	How long has it been since you took your last DL course(s)?
3	In what context were you taking DL coursework?
4	Estimate the split between amount of training vice education in the course(s) you have taken. For example, if a course was a quarter training and three quarters education (theory), select 25%-75%. Select N/A if course was not taken.
5	During the course(s), which learning context did you like the most?
6	How much of the course(s) material applies to your current job? Select N/A if course was not taken.
7	Rate your confidence in subject matter since taking the course. Select N/A if course was not taken.
8	Rate the quality of the DL course(s) in terms of providing

	applicable skills for your billet. Select N/A if course was not taken.
9	Rate your level of Subject Matter Expertise before taking DL course(s). Select N/A if course was not taken.
10	Rate your use of knowledge gained or refined from DL course(s) at work. Select N/A if course was not taken.

Table 1. Initial Survey Questions

With the existing questions presented in Table 1 as a base, the survey design effort turned to developing a survey that captured all of the areas of interest of this research. Specifically, the survey needed to query for billet application of DL education, usable knowledge gained or refined, tacit knowledge base, and transfer of knowledge to the organization in order to provide data to address the four research questions. The survey generation process began in October and consisted initially of interaction between the researcher and the Co-Thesis Advisor, Steve Iatrou. Because Steve Iatrou is the Academic Advisor for ISO certificate students, he has special insight into the students and program that helped in the refinement of the survey. The design process went through six iterations from the beginning of October until the beginning of December. After the six refinements were completed, the survey reached its final length of twenty-one questions.

With a refined survey design, the research concern became researcher bias in the questions. Because the architects of the survey were the researcher and the Academic Advisor of the program, the researcher conducted a limited usability test with a subject to determine the basic readability of the test. The test subject has a Masters Degree in Psychology and works as a counselor at California State University at Monterey Bay. She had no working knowledge of the knowledge creation process or knowledge transfer theory. She also has never taken a DL Course. The researcher presented the survey to the subject and asked her to detail anything that was not clear to her in the instructions. After reviewing the survey, her main concern was the definition of tacit knowledge. The initial definition provided was, “tacit knowledge is subjective, context-specific and not readily communicated other than by demonstration.” [Hegarty 2000]. After her input, the tacit knowledge definition provided for the survey was changed to reflect confidence in a

subject matter as well. The ultimate definition is as follows: "Tacit knowledge is defined for this study as the level of functional knowledge that you posses that is comprised of the summation of your experience, both personal and professional, your level of expertise gained through working in your billet over a period of time, and your lifelong collection of formal and informal education and training experiences. Tacit knowledge is manifested in your degree of confidence in performing specific tasks or billets, i.e., your level of confidence in being "the 'subject matter expert' for a specific role in your organization."

Once the survey was updated to reflect the "outsider" input, the survey was tested against a Professor in the IS Department at NPS. The Professor chosen for this review has extensive experience in questing for qualitative data but had no previous direct interaction with this research effort. These reviews were primarily conducted to get a professional review of the survey question design, i.e., are the questions clear and are they asking the right question? This Professor's input consisted of minor verbiage changes and guidance on overall survey construction. After this review, the survey was modified in terms of layout to group like questions. Also, each research question was addressed by two groups of questions that queried to the same question but in slightly different ways to check for intra-survey reliability, consistency in responses. The intent of these layout modifications was to identify disconnects between groups of questions that went to the same research question. That is, if two sets of targeted questions have a high correlation, then the data is viable. If two sets of targeted questions have a low correlation, then the data is unreliable for drawing conclusions and inferences.

Completing these mini-reviews led to the development of a survey that was ready for pre-testing. The survey questions are in Table 2. The choices of answers were checkboxes, radio buttons, and rating tables, respectively.

No.	Question
1	Check each course below taken through DL with NPS.
2	How long has it been since you took your last DL course(s)?
3	In what context were you taking DL coursework?
4	Estimate the split between the amount of training vice education

	in the course(s) you have taken. For example, if a course was a quarter training and three quarters education (theory), select 25%-75%. Select N/A if course was not taken.
5	During the course(s), which learning context did you like the most?
6	How much of the course(s) material applies to your current job? Select N/A if course was not taken.
7	Rate your confidence in subject matter since taking the course. Select N/A if course was not taken.
8	Rate the quality of the DL course(s) in terms of providing applicable skills for your billet. Select N/A if course was not taken.
9	Rate your level of Subject Matter Expertise before taking DL course(s). Select N/A if course was not taken.
10	Rate your use of knowledge gained or refined from DL course(s) at work. Select N/A if course was not taken.
11	Prior to taking your DL coursework, how often were you called upon to use skills later refined through a DL course in the fulfillment of your operational billet duties for the following courses? Select N/A if course was not taken.
12	How often did you use those skills gained or refined WHILE taking a DL course in fulfillment of your operational billet responsibilities for the following courses? Select N/A if course was not taken.
13	AFTER completing a DL course, how often did you use those specific skills gained or refined in the fulfillment of your operational billet duties for the following courses? Select N/A if course was not taken.
14	What level of usable knowledge gained or refined from your DL coursework was completely new to you for the following courses? Select N/A if course was not taken.
15	What level of usable knowledge gained from your DL coursework was a refinement of existing knowledge for you from the following courses? Select N/A if course was not taken.
16	In terms of your tacit knowledge base, rate your mastery level of the skill sets learned through DL work for the following scenarios regarding IO 3100? Do not answer this question if you have not taken IO 3100. Select N/A for scenarios that do not apply; e.g. if you are

	currently taking IO 3100, select N/A for the scenarios based AFTER taking a course and one year AFTER taking a course.
17	In terms of your tacit knowledge base, rate your mastery level of the skill sets learned through DL work for the following scenarios regarding SS 3011? Do not answer this question if you have not taken SS 3011. Select N/A for scenarios that do not apply; e.g. if you are currently taking SS 3011, select N/A for the scenarios based AFTER taking a course and one year AFTER taking a course.
18	In terms of your tacit knowledge base, rate your mastery level of the skill sets learned through DL work for the following scenarios regarding IS 3502? Do not answer this question if you have not taken IS 3502. Select N/A for scenarios that do not apply; e.g. if you are currently taking SS 3011, select N/A for the scenarios based AFTER taking a course and one year AFTER taking a course.
19	In terms of your tacit knowledge base, rate your mastery level of the skill sets learned through DL work for the following scenarios regarding CC 3000? Do not answer this question if you have not taken CC 3000. Select N/A for scenarios that do not apply; e.g. if you are currently taking SS 3011, select N/A for the scenarios based AFTER taking a course and one year AFTER taking a course.
20	How much of new knowledge acquired through DL coursework was incorporated into procedures, directions, SOPs, OJT, informal training, etc. within your work section WHILE you were taking one of the follwing DL courses?
21	How much of new knowledge acquired through DL coursework was incorporated into procedures, directions, SOPs, OJT, informal training, etc. within your work section AFTER you took one of the following DL courses?

Table 2. Pre-Test Survey Questions

2. Survey Pre-Test and Results

After refining the survey as described, a pre-test was conducted prior to fielding the survey. The pre-test was applied to eight resident students at NPS from four different curricula. Each resident student has taken at least one of the resident equivalent courses

corresponding to the respective courses in the ISO curriculum. The resident curricula represented in the pre-test were Information Technology Management, Space Systems, Information Operations, and Joint Command and Control Systems. Each curriculum was represented by two students. Two of the students had taken all four of the resident equivalent classes in the ISO program. Four of the students had taken two of the classes. Two of the students had taken one of the classes. The resident students were asked to answer the questions and to note any instruction that was not clear. The pre-test was fielded with a brief email introduction but no additional instruction other than the survey questions themselves and a definition of tacit knowledge for this survey. The email instructions were as follows:

Special Instructions for Pre-Test

Gentlemen,

The purpose of this pre-test is to help me validate the clarity of the instructions on my survey and exercise the survey tool mechanisms. The DL courses are listed below with their resident equivalents. I am asking you for your input because you have taken some or all of the target courses in a resident or DL setting. The aim of my research is to quantify the amount of usable knowledge gained by personnel taking DL coursework through NPS while serving in operational billets.

Course Equivalents

IO 3100 → IW 3101 Introduction to Information Operations

SS 3011 → SS 3011 Introduction to Space Operations

IS 3502 → IS 3502 Introduction to WAN/LAN Networking

CC 3000 → CC 3000 Introduction to Command and Control

----------General Instructions----------

These are the basic instructions for these surveys are as follows:

DL is acronym for Distributed Learning.

Note: Tacit knowledge is defined for this study as the level of functional knowledge that you posses that is comprised of the summation of your experience, both personal and professional, your level of expertise gained through working in your billet over a period of time, and your lifelong collection of formal and informal education and training experiences. Tacit knowledge is manifested in your degree of confidence in

performing specific tasks or billets, i.e., your level of confidence in being "the subject matter expert" for a specific role in your organization.

The step-by-step is as follows:

- Click on this link http://131.120.251.62/OCL/survey.asp?survey=75 (December 2005)
- Questions 1-6 and # 18 are demographic questions, so just click any radio button or checkbox.
- Assume a "willing suspension of belief" in regards to the rest of the questions and take a SWAG at an answer as if you were in the Fleet and taking these courses via DL.
- If the question is about a course you have not taken, please respond with a N/A.
- Click the FINISH button at the bottom of the survey.
- Please send me an email with either specific questions or parts of questions that did not make sense to you or an email saying you understood the directions as-is.

Of course, none of your responses will be used in any manner other than indicated in the above instructions. You can expect complete anonymity as to your responses; in fact, the survey tool does not collect your name or email information. Thanks for giving me a hand with this.

R/S
Scott Hortman

3. Final Survey Pretest Results

The resulting comments were synthesized for editing the survey design as follows:

- Each respondent reported that the layout of the survey made reading the questions more difficult than it needed to be.
- Some respondents reported trouble getting access to the survey.
- Multiple respondents did not like the various factors involving the answer choices. Specifically, negative trends that were highlighted in the pretest regarding answers were lack of uniformity in scale between some sets of

answers, lack of a N/A or "all of the above" option on some answers, and lack of a consistent grouping of like subjects.

- No respondent reported significant "readability" or "understandability" issues beyond an assertion that grouping like subjects would make it easier for a survey recipient to answer like subjects with consistency.

These trends were addressed in the Final Survey Design as follows:

- The design layout and connectivity issues were addressed by moving the final survey to a professionally operated and maintained survey tool.
- The answer portions of the final survey were changed to achieve a more consistent, user-friendly characteristic in accordance with the comments from the pretest results.
- The questions were grouped in a logical way that supported the research questions and demographic information.

4. Final Survey Design

The final survey design is presented in screenshots in exactly the way the survey was presented to recipients. The screenshots are in the order in which those respective screens appear when taking the survey. The final survey is as follows:

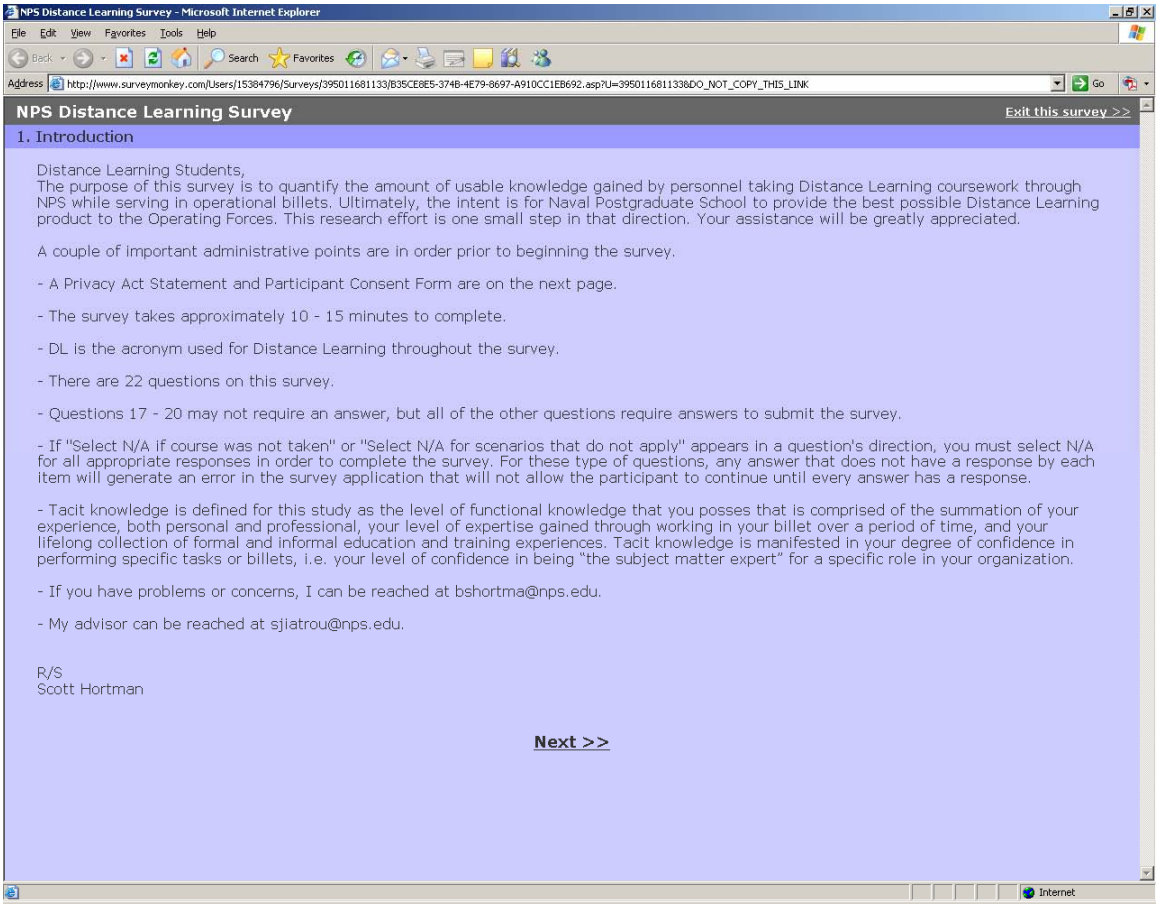


Figure 18. Final Survey Introduction

The Introduction page introduces the research to the recipient and gives information such as definitions, length of survey, and special response direction designed to aid the user in taking the survey with minimal confusion.

After clicking “NEXT”, the user arrives at this page.

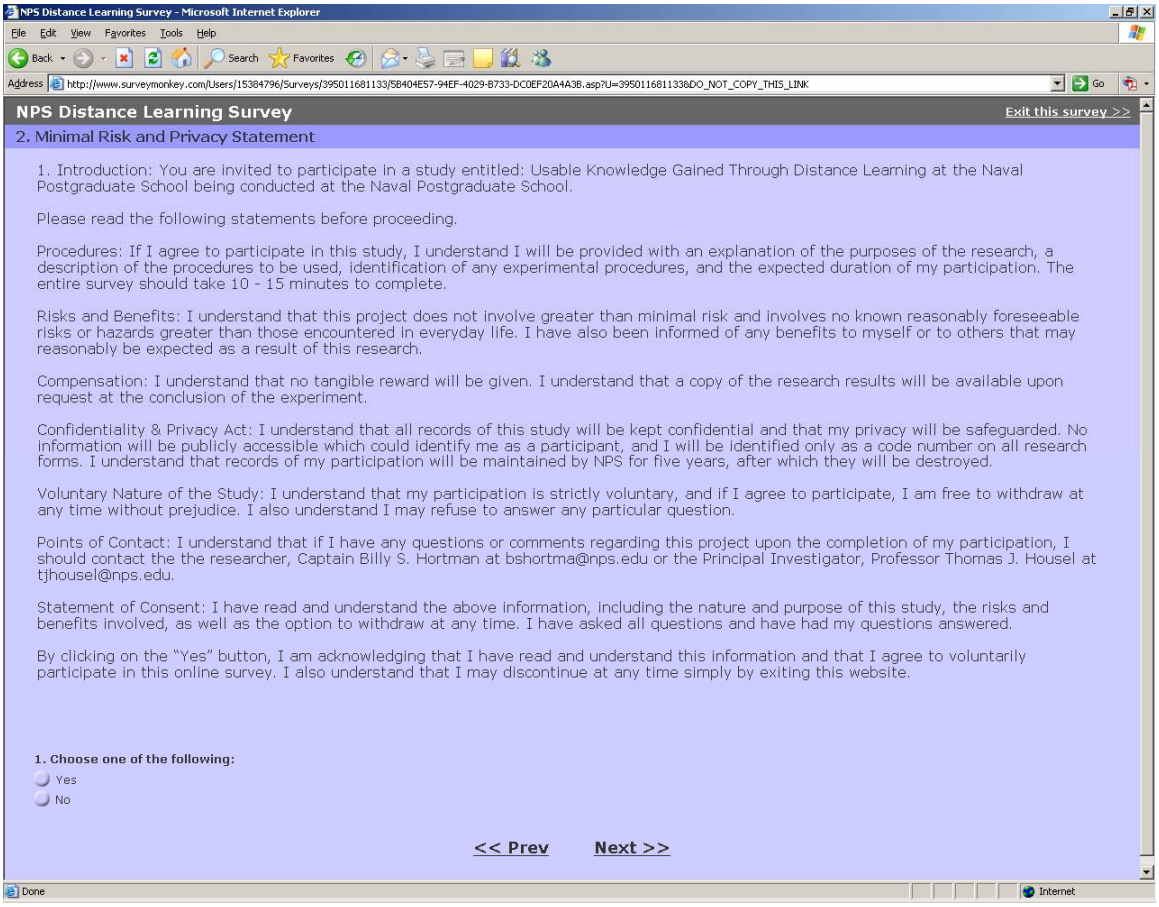


Figure 19. Minimal Risk and Privacy Statement

The “Minimal Risk and Privacy Statement” page provides the users with their rights involved with this research and provides a feedback mechanism for them to agree to acknowledge their consent prior to beginning the survey.

After clicking “NEXT”, the user arrives at this page.

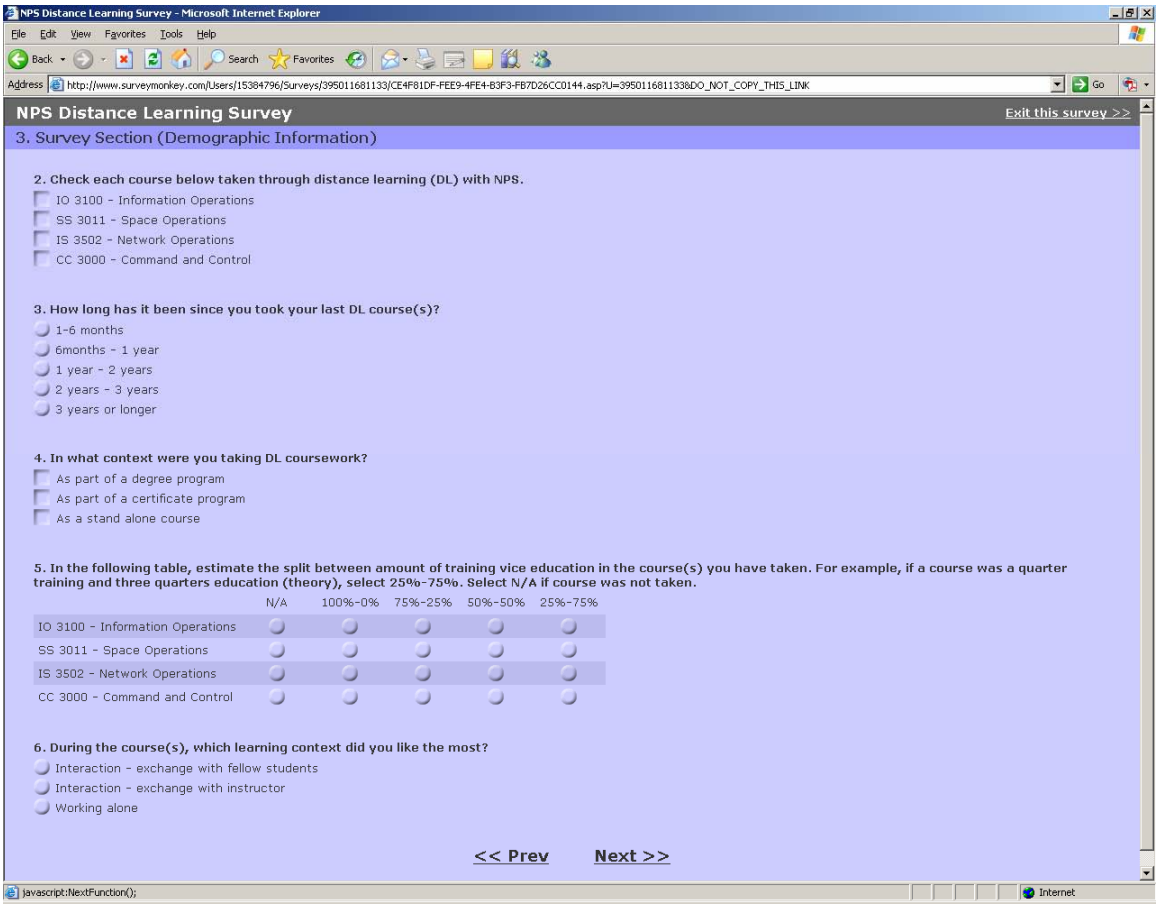


Figure 20. Demographic Information

The reason for collecting demographic information is to help provide insight into the survey responses during data analysis.

After clicking “NEXT”, the user arrives at this page.

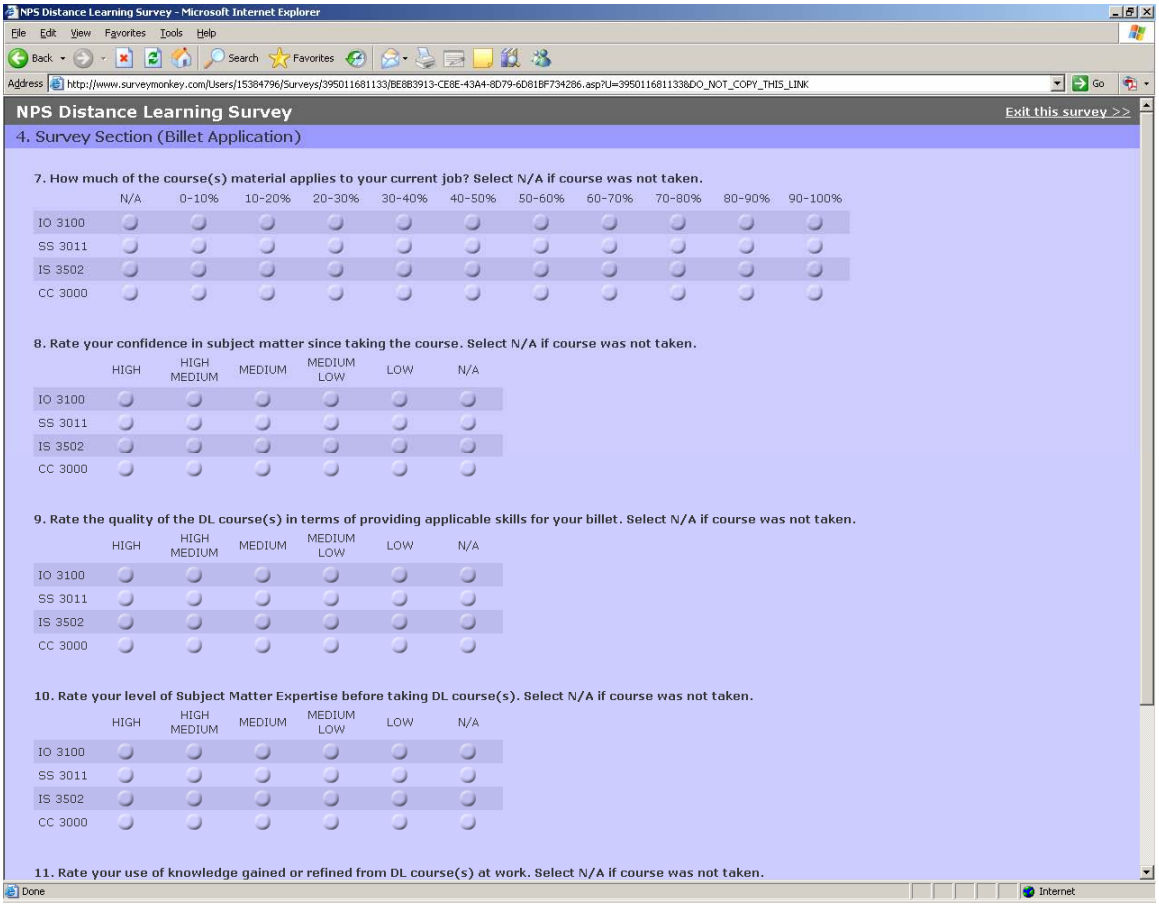


Figure 21. Billet Application

All of these questions query to the billet application of knowledge gained or refined through DL coursework.

This page is a continuation of the previous page. Because the screen requires a scrollbar to view it in its entirety, the screen was adjusted to capture question 11 and its associated responses for this screenshot.

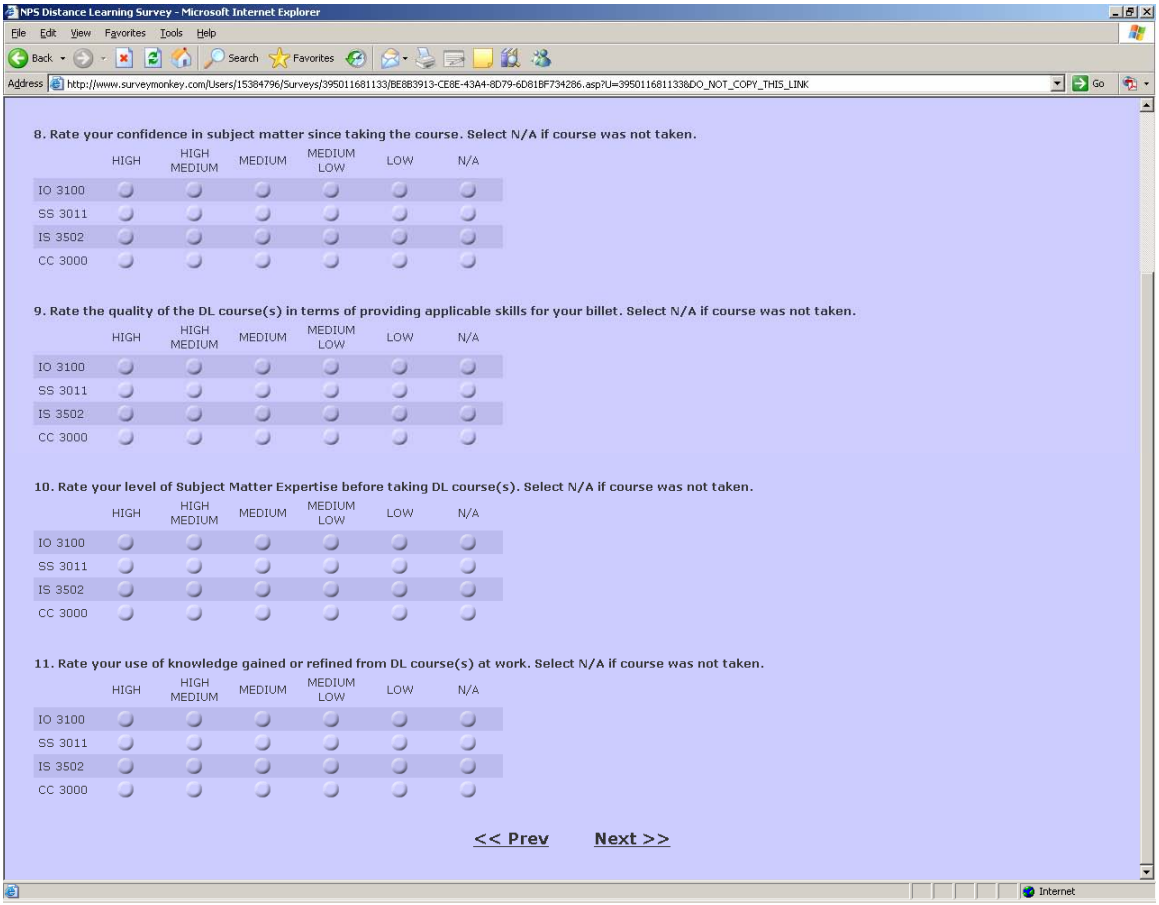


Figure 22. Billet Application Continued

After clicking “NEXT”, the user arrives at this page.

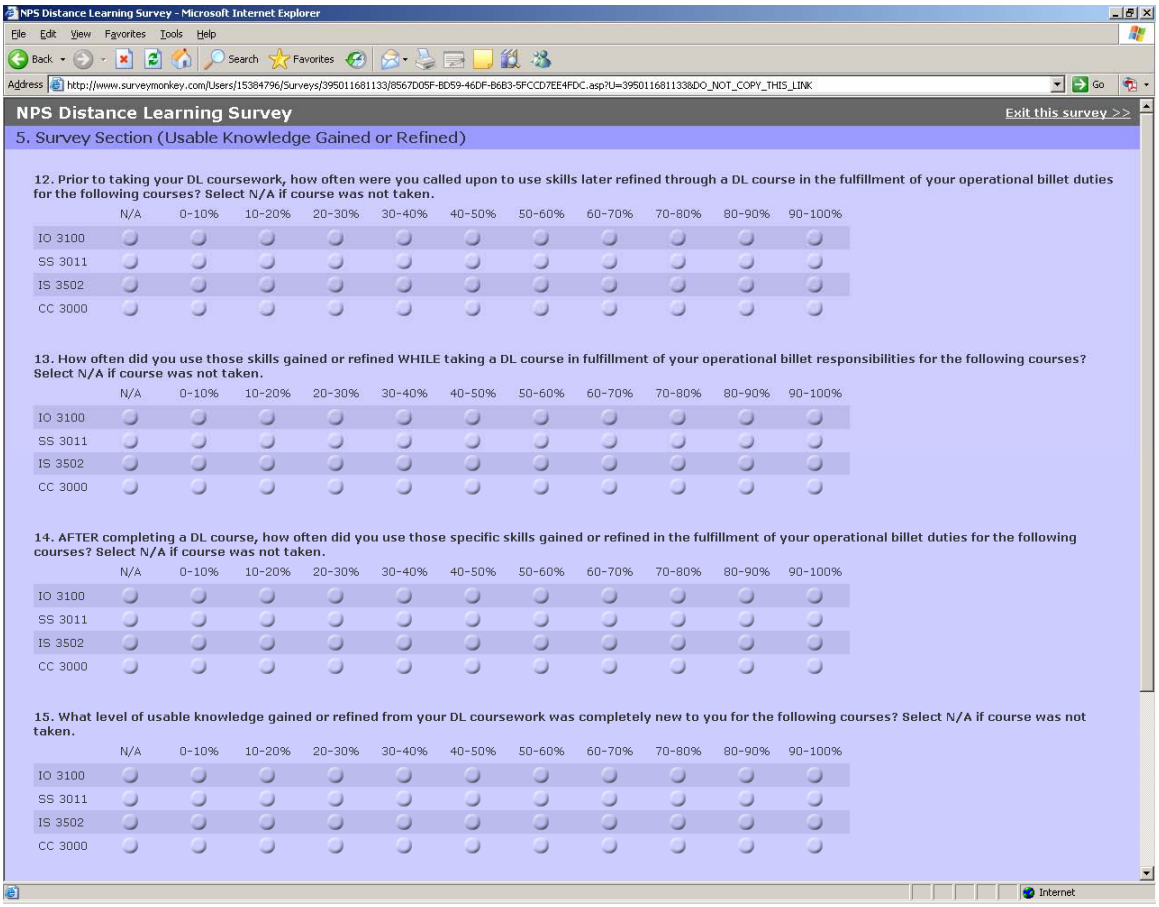


Figure 23. Usable Knowledge Gained or Refined

This section is questioning how much usable knowledge was gained or refined through DL coursework in specific courses and in specific times relative to taking the course(s).

This page is a continuation of the previous page in order to capture every question in this section.

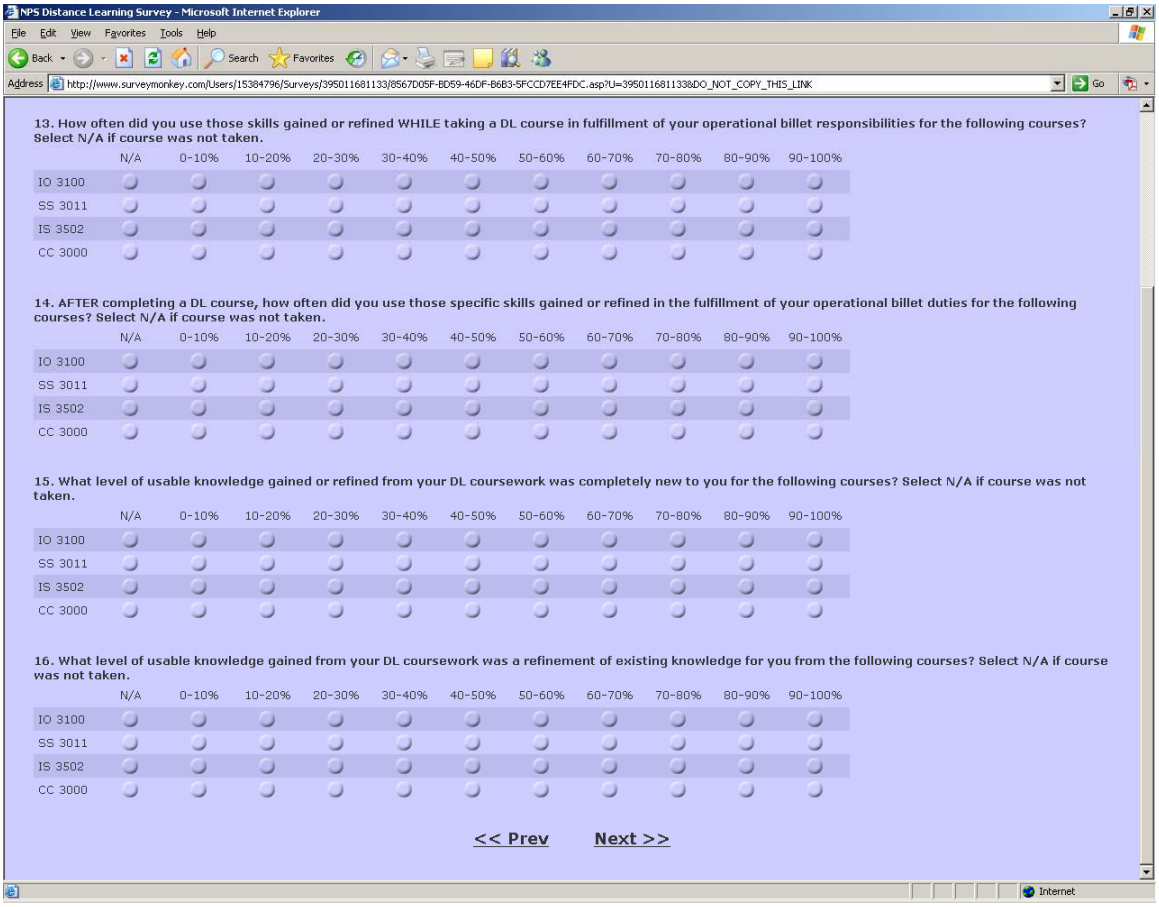


Figure 24. Usable Knowledge Gained or Refined Continued

After clicking “NEXT”, the user arrives at this page.

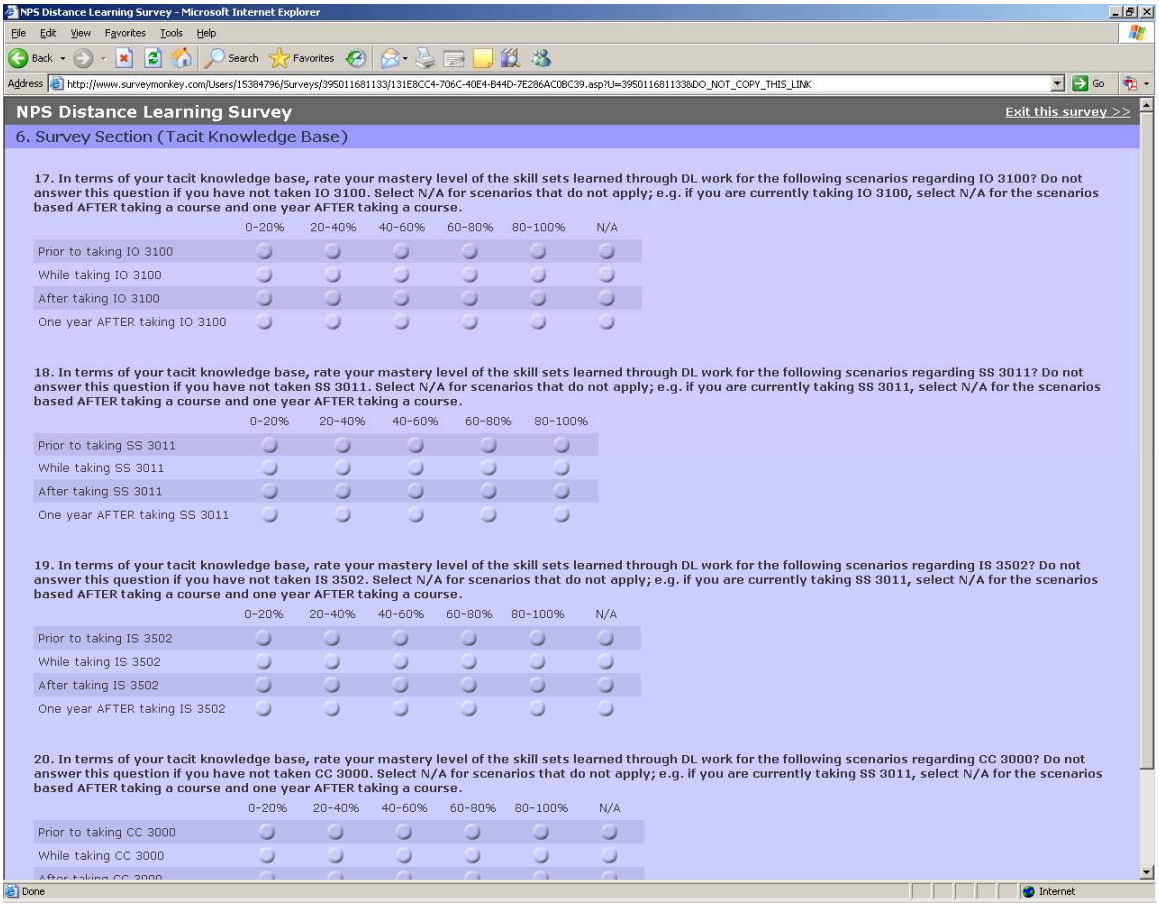


Figure 25. Tacit Knowledge Base

This section asks the recipient questions targeted to capture the effects of DL coursework on their tacit knowledge base time-respective of when they took a course(s).

This is a continuation of the previous screen.

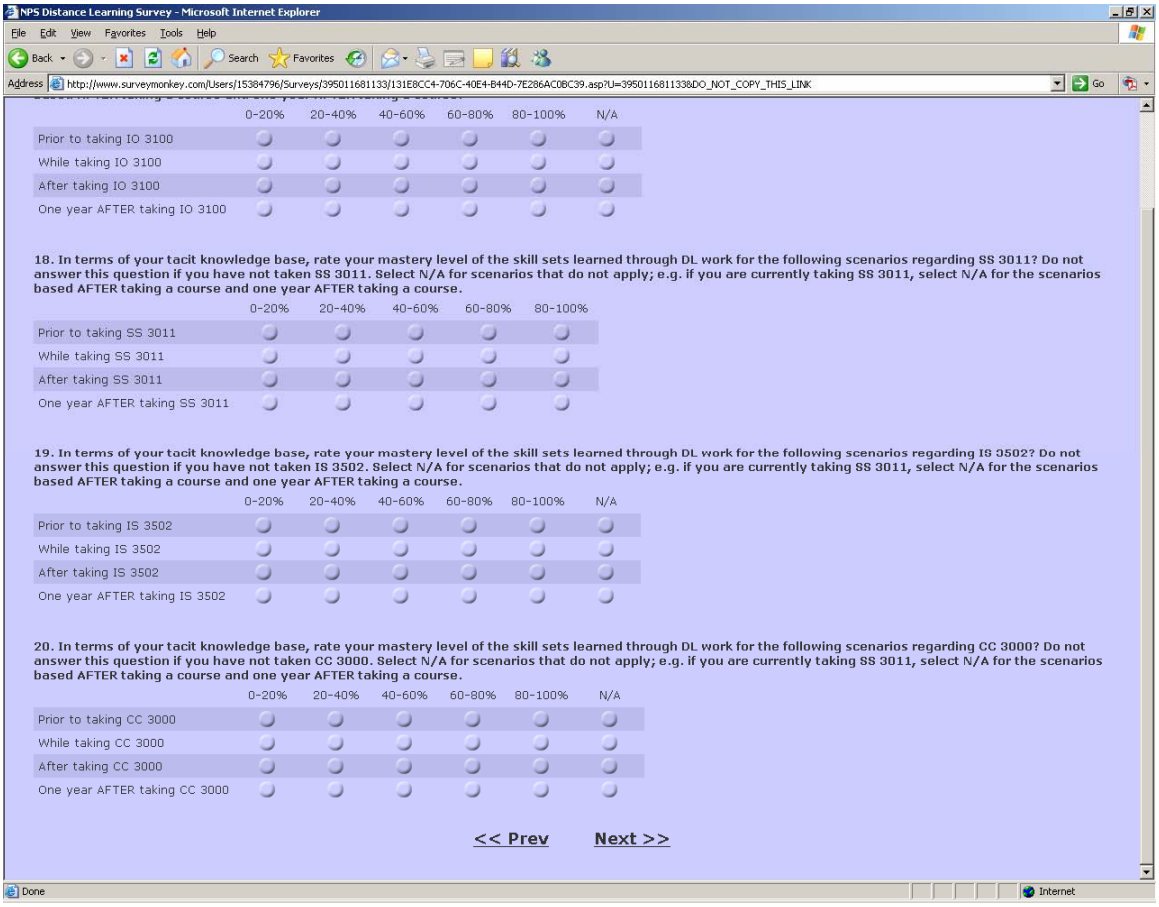


Figure 26. Tacit Knowledge Base Continued

After clicking “NEXT”, the user arrives at this page.

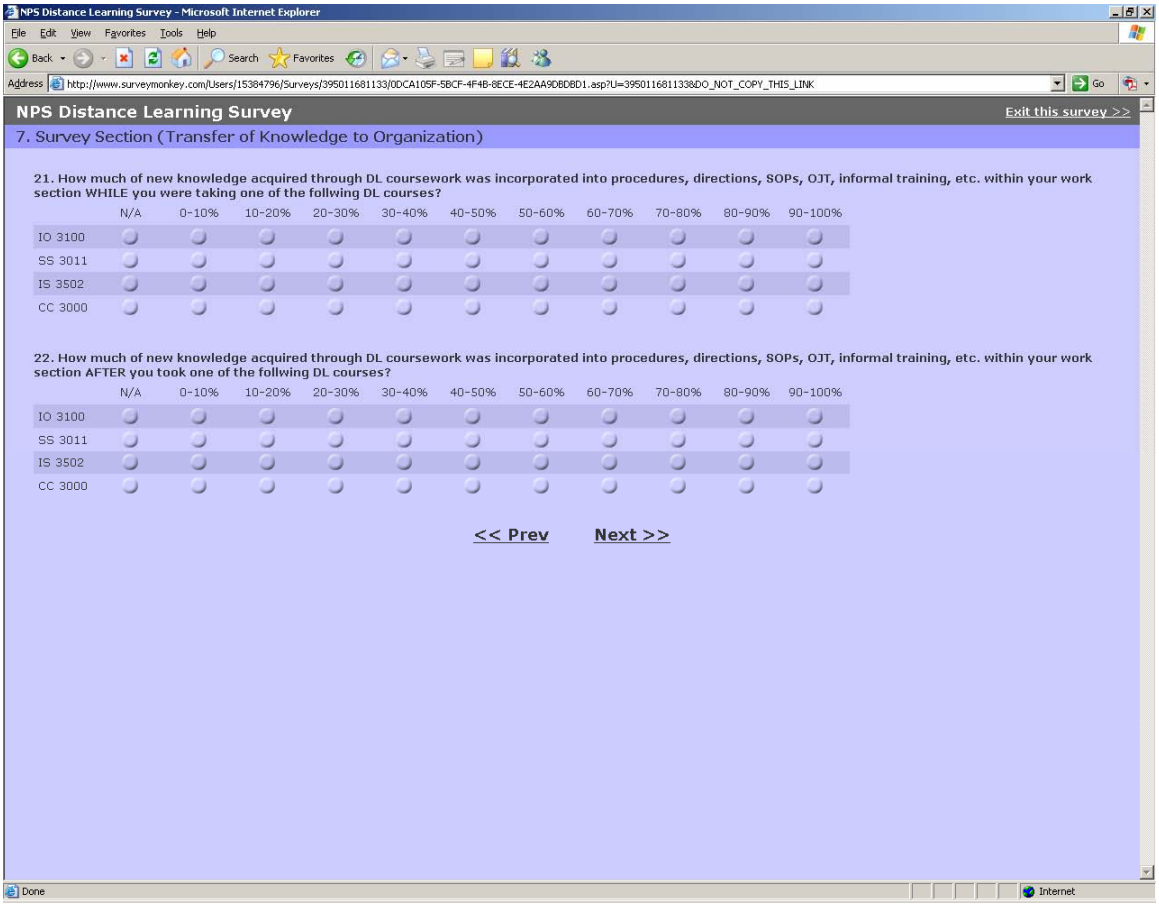


Figure 27. Transfer of Knowledge to Organization

These questions are concerned with how much knowledge gained or refined through DL coursework is transferred to the organization. Clicking “NEXT” sends the recipient to a conclusion screen that thanks them for their participation.

C. DATA COLLECTION OBJECTIVES

Beyond the esthetics of the design layout, the survey design had to query for data that would provide insight into the research questions and minimize the very real limitation of self-report that is inherent to a survey as a data collection tool. Additionally,

the fielding procedure required a concentrated effort to reach as much of the target population as possible and minimize impact on survey recipient's schedule.

1. Map Survey to Research Questions

The final survey was designed to group like questions that queried for data that would be relevant to a specific research question. The "Billet Application" section of the survey shown in Figures 21 and 22 are intended to map to the research question "Does NPS effectively and quickly distribute graduate – level skills via DL to the personnel serving in the operational billets?" The "Tacit Knowledge Base" section of the survey shown in Figures 25 and 26 are intended to map to the research question "Is NPS DL coursework comparable to resident coursework in terms of usable knowledge gained?" The "Transfer to Organization" section of the survey shown in Figure 27 is intended to map to the research question "Is there any transfer of knowledge from a DL student to their organization?" The "Usable Knowledge Gained or Refined"" section of the survey shown in Figures 23 and 24 are intended to map to the research question "Can frequency of use of skills learned through DL be used as a measure of effectiveness for the DL program at NPS?"

2. Control Measures to Minimize or Identify Self Report

Because a survey was the primary data collection means used in this research and because self-report is a potential weakness in a survey, the survey used was designed to ask for the desired data in two places in the survey with slightly different wording. One question set will query directly to the desired data response. Its corresponding question set queries to the underlying concept. The design is intended to mask the direct association of the question sets so that the recipient does not recognize the association. The desire is that after the data is collected those pairs of question sets can be correlated. The assumption is that a high correlation between respective data sets leads to a higher level of confidence in the direct query question set's respondent data. The converse is expected as well. The questions sets associated with their respective research questions are as follows:

1) Does NPS effectively and quickly distribute graduate – level skills via DL to the personnel serving in the operational billets?

- Primary Survey Questions: Survey Section (Billet Application) Questions 7-11
- Associated Survey Questions: Questions 12, 13, and 14

The primary question set for this research question does not differentiate between explicit or tacit knowledge. The questions focus on applicable skills gained in relation to billet, the degree on confidence in the subject material time relative to taking the course(s), and use of knowledge gained in performance of billet duties. The associated question set queries specifically to the frequency of use of skills gained or refined through DL coursework before, during, and after taking a course(s). The expectation is that responses about how often new knowledge is used at work (frequency of use) will correlate with billet specific responses from the primary question set.

2) Is NPS DL coursework comparable to resident coursework in terms of usable knowledge gained?

- Primary Survey Questions: Survey Section (Tacit Knowledge Base) Questions 17-20
- Associated Survey Questions: Questions 8 and 10

Each class is individually compared respective of this survey section to the hypothesis curve because the hypothesis curve demonstrates the expected growth of an individual's tacit knowledge base during DL coursework. If the individual course curves correlate with the hypothesis curve, then the suggestion that DL is comparable to resident coursework in terms of usable knowledge gained because the hypothesis curve was built from a literature review that was not context specific. Additionally, the primary question set queries tacit knowledge base within the given definition for each course in relation to the following: prior to taking the course, while taking the course, after taking the course, and one year after taking the course. The associated question set asks for responses regarding confidence and level of subject matter expertise before and after the course(s). The expectation is that the associated question set will correlate with the primary set for before and after time periods because the terms "confidence" and "subject matter expertise" were used in the tacit knowledge definition included for this survey.

3) Is there any transfer of knowledge from a DL student to their organization?

- Primary Survey Questions: Survey Section (Transfer of Knowledge to Organization) Questions 21-22
- Associated Survey Questions: Questions 7, 12, 13, and 14

The primary question set asks specifically how much of the new knowledge gained or refined through DL coursework was incorporated into procedures, SOPs, OJT, etc. within the student's work section. Essentially, how much of the new knowledge gained or refined was transferred to explicit form by the student to remain in the work section. The associated question set queries frequency of use of skills and how much of the course material applies to the current billet. The expectation is that knowledge identified as high frequency of use would affect processes enough that some of that new knowledge would need to be codified within that individual's work section.

4) Can frequency of use of skills learned through DL be used as a measure of effectiveness for the DL program at NPS?

- Primary Survey Questions: Survey Section (Usable Knowledge Gained or Refined) Questions 12-16
- Associated Survey Questions: Questions 9 and 11

The primary question set queries frequency of use specifically. The associated question set asks for billet applicable skills learned and use of knowledge gained or refined through DL coursework. The expectation is that the associated question set will tightly correlate with frequency of use because the questions are work performance related.

3. Survey Fielding Procedure

After completing the survey design, fielding the survey was the next step. Because the population for this survey is so diverse geographically and because a significant portion this population may be busy in the operating forces, a key concern in fielding the survey was to minimize impact upon the recipients. In order to maximize responses, the Academic Associate for the 271 curriculum sent out a preparatory email to the distribution list explaining the intent and importance of this survey on the first Friday in February. The survey was sent to the distribution list on the following Monday. The survey remained open for two weeks. At the end of the two week period, an email was

sent to the distribution list thanking those that had responded and encouraging recipients to complete the survey if they had not responded. The survey was closed at the end of three weeks. Only two additional responses were collected during the final week.

D. DATA COLLECTION RESULTS

The data collection results focus on two elements, the survey response rate and the actual raw data results. The response rate is important in order to form a judgment on the validity of the results. The actual raw data is important because it becomes the basis for the analysis.

1. Response Rate

The total population was estimated at 236 students. This figure came from the academic records of the Academic Advisor for the 271 curriculum. The entire population was placed upon the survey distribution list. Out of the 236 surveys distributed, 54 came back as undeliverable, resulting in an actual reachable population of 182. An important observation is that contact information for these students is not maintained in a current status. For example, former students that used government email accounts during DL coursework and have since moved to a different job are not reachable. Out of the 182 surveys that were received, 38 students answered the survey. This translates to a 20% response rate from the reachable population. Some of the questions were not answered by every respondent, but that information is captured in the raw data.

2. Raw Data Results

The raw results are presented in the following screenshots.

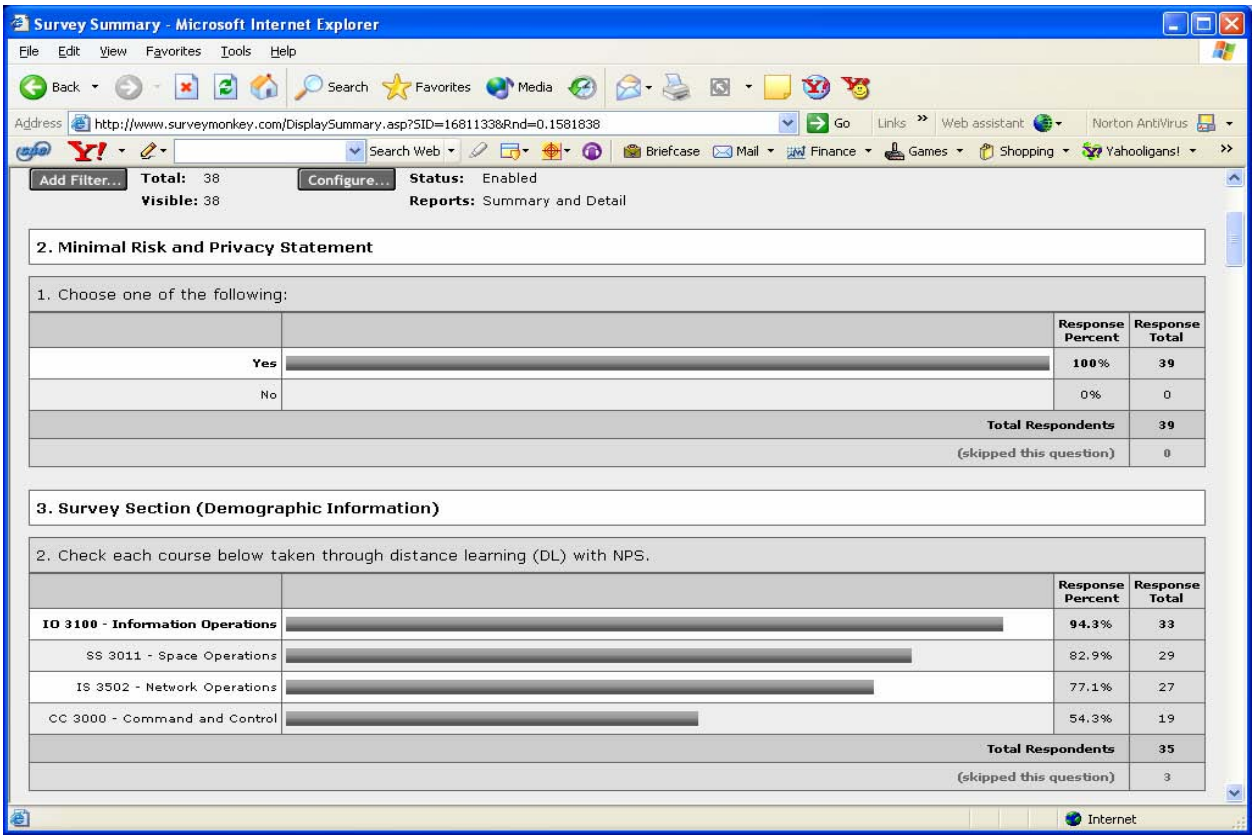


Figure 28. Raw Survey Results

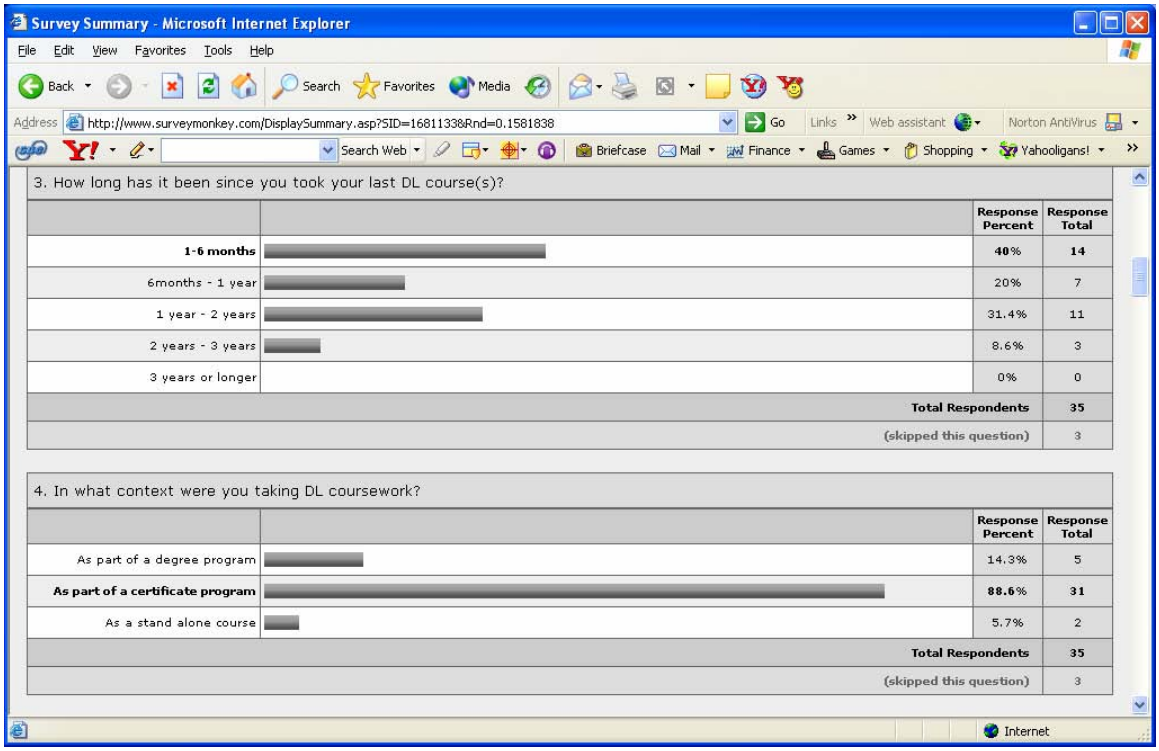


Figure 29. Raw Survey Results Continued

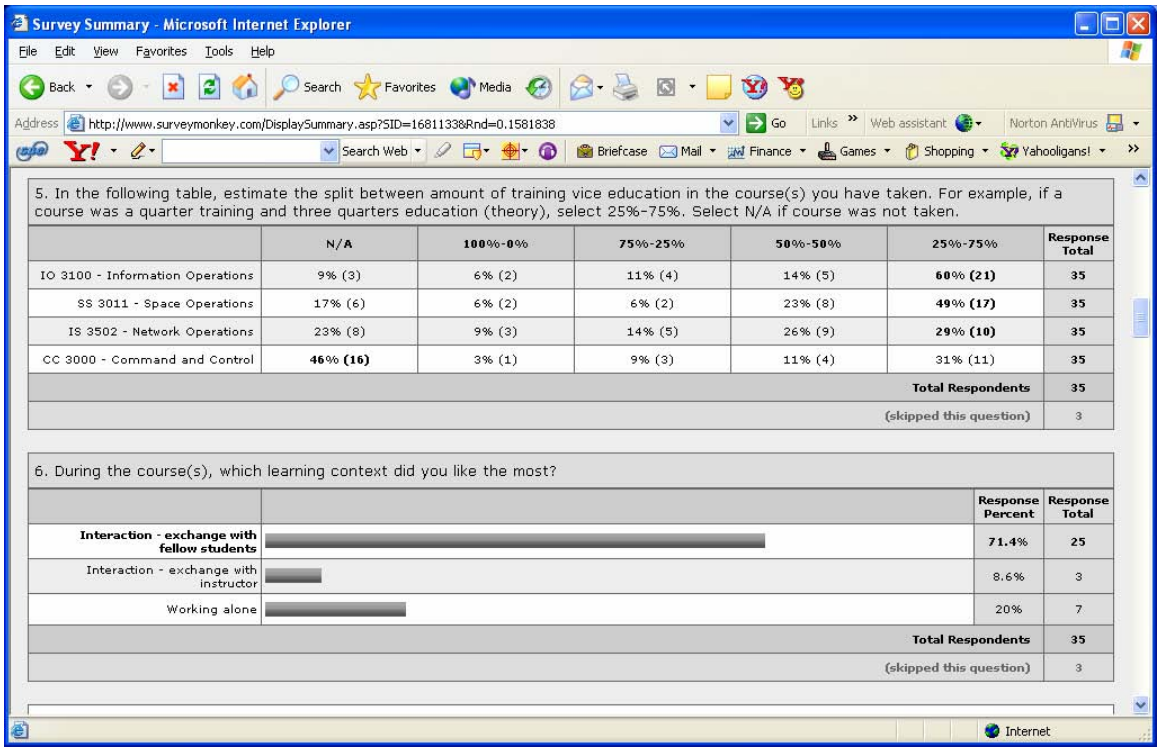
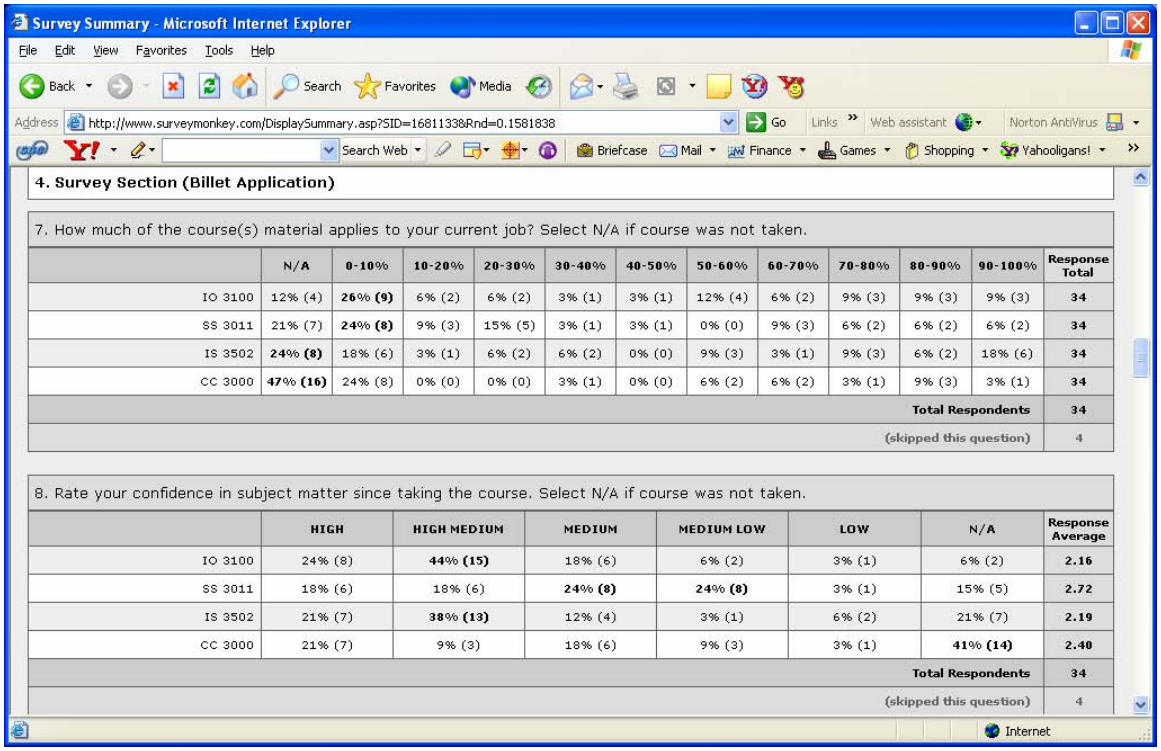


Figure 30. Raw Survey Results Continued



4. Survey Section (Billet Application)

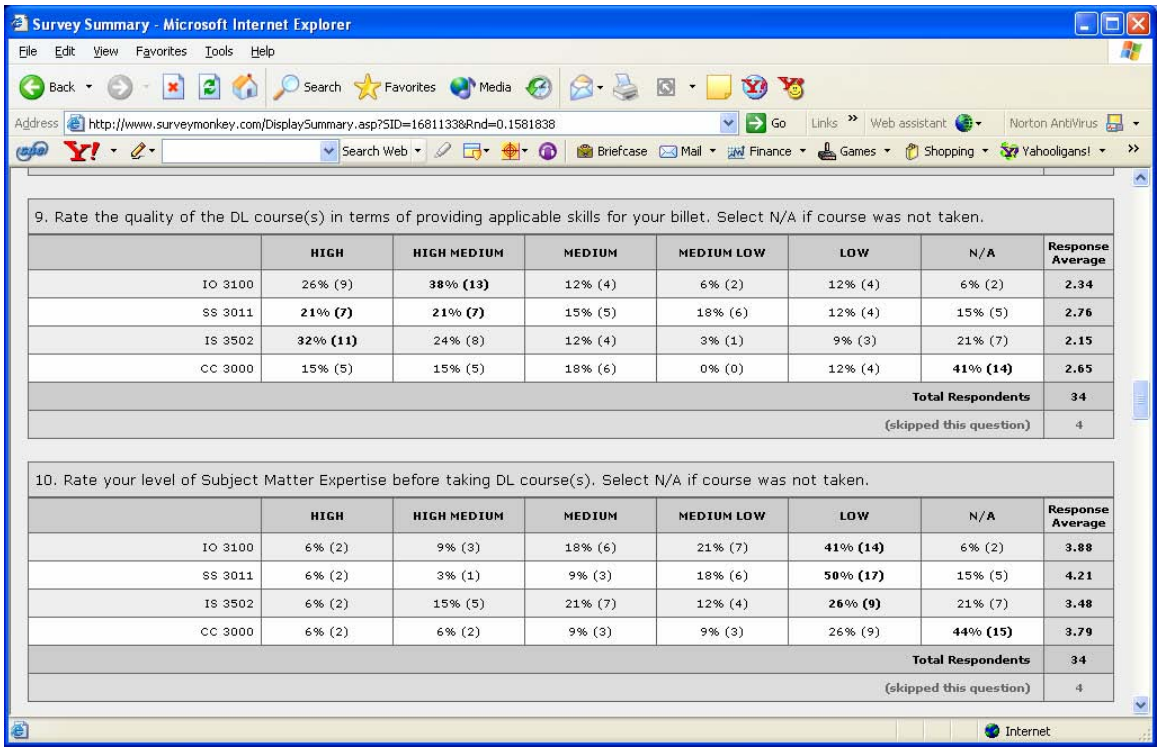
7. How much of the course(s) material applies to your current job? Select N/A if course was not taken.

	N/A	0-10%	10-20%	20-30%	30-40%	40-50%	50-60%	60-70%	70-80%	80-90%	90-100%	Response Total
IO 3100	12% (4)	**26% (9)**	6% (2)	6% (2)	3% (1)	3% (1)	12% (4)	6% (2)	9% (3)	9% (3)	9% (3)	34
SS 3011	21% (7)	**24% (8)**	9% (3)	15% (5)	3% (1)	3% (1)	0% (0)	9% (3)	6% (2)	6% (2)	6% (2)	34
IS 3502	**24% (8)**	18% (6)	3% (1)	6% (2)	6% (2)	0% (0)	9% (3)	3% (1)	9% (3)	6% (2)	18% (6)	34
CC 3000	**47% (16)**	24% (8)	0% (0)	0% (0)	3% (1)	0% (0)	6% (2)	6% (2)	3% (1)	9% (3)	3% (1)	34
											Total Respondents	34
											(skipped this question)	4

8. Rate your confidence in subject matter since taking the course. Select N/A if course was not taken.

	HIGH	HIGH MEDIUM	MEDIUM	MEDIUM LOW	LOW	N/A	Response Average
IO 3100	24% (8)	**44% (15)**	18% (6)	6% (2)	3% (1)	6% (2)	**2.16**
SS 3011	18% (6)	18% (6)	**24% (8)**	**24% (8)**	3% (1)	15% (5)	**2.72**
IS 3502	21% (7)	**38% (13)**	12% (4)	3% (1)	6% (2)	21% (7)	**2.19**
CC 3000	21% (7)	9% (3)	18% (6)	9% (3)	3% (1)	**41% (14)**	**2.40**
						Total Respondents	34
						(skipped this question)	4

Figure 31. Raw Survey Results Continued



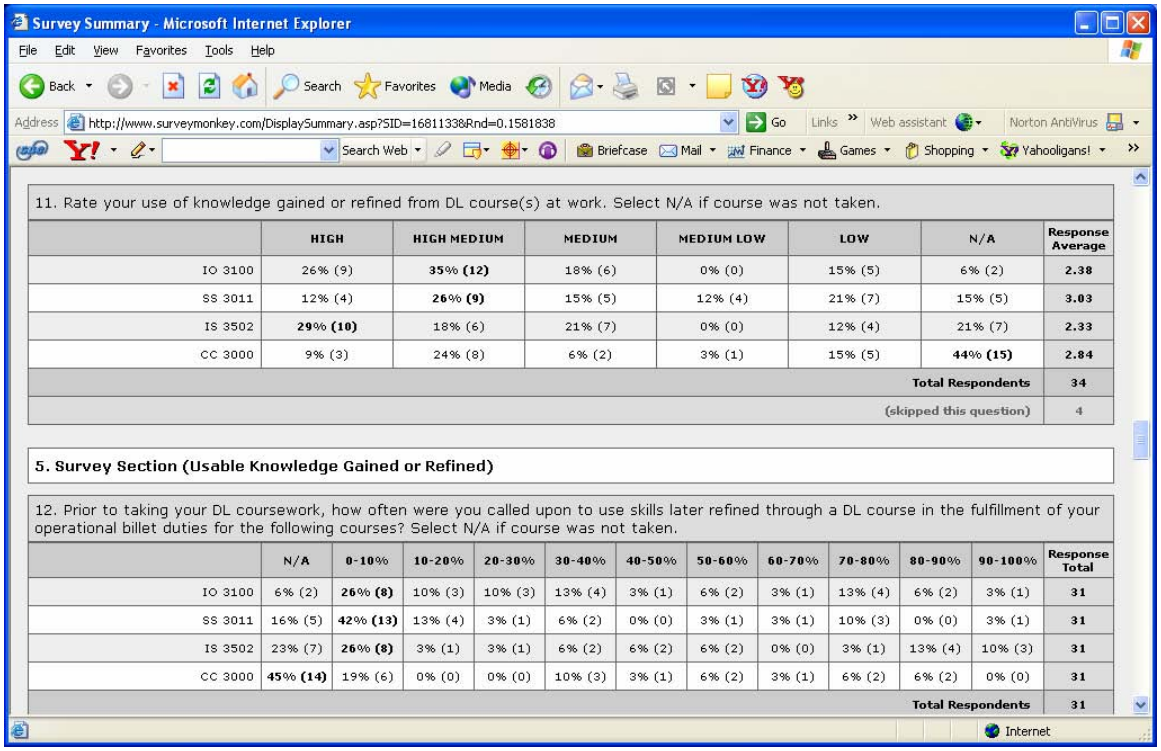
9. Rate the quality of the DL course(s) in terms of providing applicable skills for your billet. Select N/A if course was not taken.

	HIGH	HIGH MEDIUM	MEDIUM	MEDIUM LOW	LOW	N/A	Response Average
IO 3100	26% (9)	**38% (13)**	12% (4)	6% (2)	12% (4)	6% (2)	**2.34**
SS 3011	**21% (7)**	**21% (7)**	15% (5)	18% (6)	12% (4)	15% (5)	**2.76**
IS 3502	**32% (11)**	24% (8)	12% (4)	3% (1)	9% (3)	21% (7)	**2.15**
CC 3000	15% (5)	15% (5)	18% (6)	0% (0)	12% (4)	**41% (14)**	**2.65**
						Total Respondents	34
						(skipped this question)	4

10. Rate your level of Subject Matter Expertise before taking DL course(s). Select N/A if course was not taken.

	HIGH	HIGH MEDIUM	MEDIUM	MEDIUM LOW	LOW	N/A	Response Average
IO 3100	6% (2)	9% (3)	18% (6)	21% (7)	**41% (14)**	6% (2)	**3.88**
SS 3011	6% (2)	3% (1)	9% (3)	18% (6)	**50% (17)**	15% (5)	**4.21**
IS 3502	6% (2)	15% (5)	21% (7)	12% (4)	**26% (9)**	21% (7)	**3.48**
CC 3000	6% (2)	6% (2)	9% (3)	9% (3)	26% (9)	**44% (15)**	**3.79**
						Total Respondents	34
						(skipped this question)	4

Figure 32. Raw Survey Results Continued



11. Rate your use of knowledge gained or refined from DL course(s) at work. Select N/A if course was not taken.

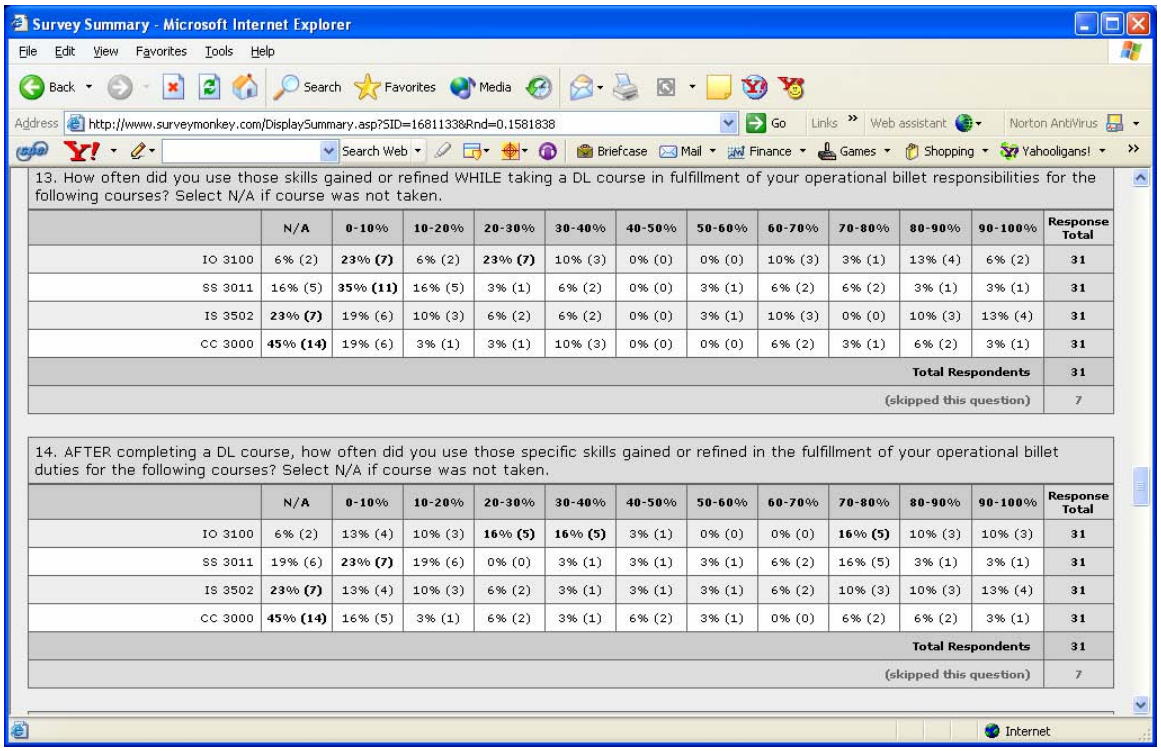
	HIGH	HIGH MEDIUM	MEDIUM	MEDIUM LOW	LOW	N/A	Response Average
IO 3100	26% (9)	**35% (12)**	18% (6)	0% (0)	15% (5)	6% (2)	**2.38**
SS 3011	12% (4)	**26% (9)**	15% (5)	12% (4)	21% (7)	15% (5)	**3.03**
IS 3502	**29% (10)**	18% (6)	21% (7)	0% (0)	12% (4)	21% (7)	**2.33**
CC 3000	9% (3)	24% (8)	6% (2)	3% (1)	15% (5)	**44% (15)**	**2.84**
						Total Respondents	**34**
						(skipped this question)	**4**

5. Survey Section (Usable Knowledge Gained or Refined)

12. Prior to taking your DL coursework, how often were you called upon to use skills later refined through a DL course in the fulfillment of your operational billet duties for the following courses? Select N/A if course was not taken.

	N/A	0-10%	10-20%	20-30%	30-40%	40-50%	50-60%	60-70%	70-80%	80-90%	90-100%	Response Total
IO 3100	6% (2)	**26% (8)**	10% (3)	10% (3)	13% (4)	3% (1)	6% (2)	3% (1)	13% (4)	6% (2)	3% (1)	**31**
SS 3011	16% (5)	**42% (13)**	13% (4)	3% (1)	6% (2)	0% (0)	3% (1)	3% (1)	10% (3)	0% (0)	3% (1)	**31**
IS 3502	23% (7)	**26% (8)**	3% (1)	3% (1)	6% (2)	6% (2)	6% (2)	0% (0)	3% (1)	13% (4)	10% (3)	**31**
CC 3000	**45% (14)**	19% (6)	0% (0)	0% (0)	10% (3)	3% (1)	6% (2)	3% (1)	6% (2)	6% (2)	0% (0)	**31**
											Total Respondents	**31**

Figure 33. Raw Survey Results Continued



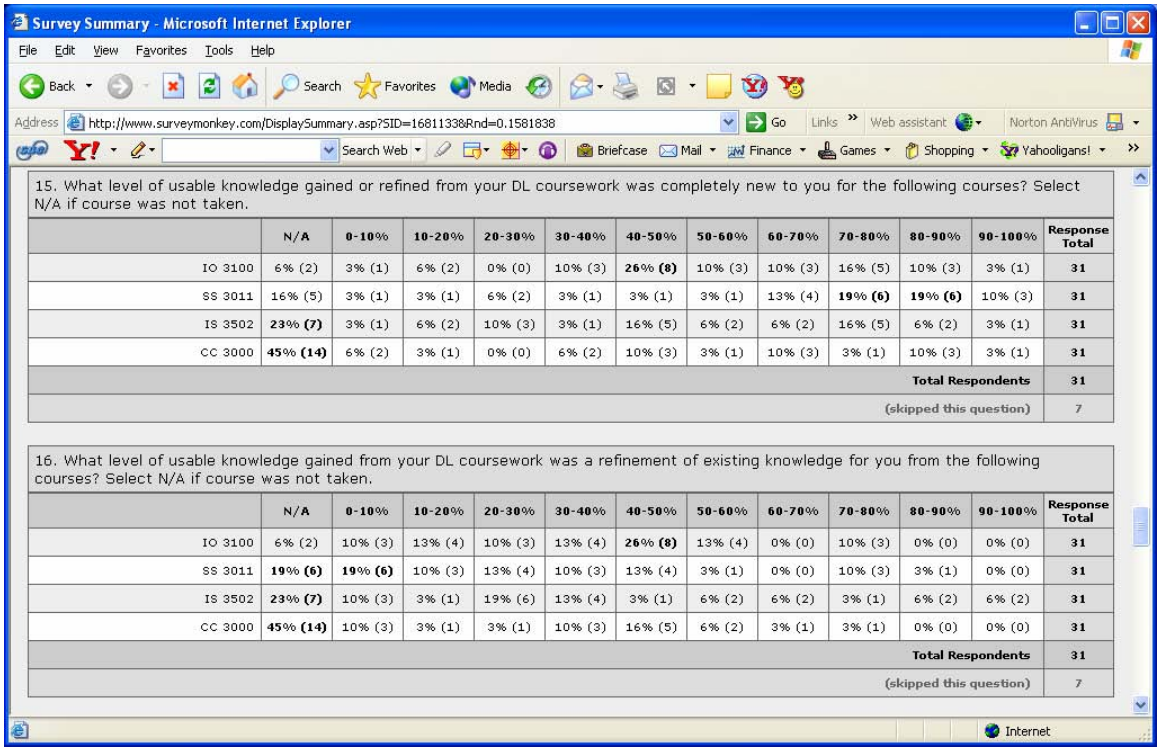
13. How often did you use those skills gained or refined WHILE taking a DL course in fulfillment of your operational billet responsibilities for the following courses? Select N/A if course was not taken.

	N/A	0-10%	10-20%	20-30%	30-40%	40-50%	50-60%	60-70%	70-80%	80-90%	90-100%	Response Total
IO 3100	6% (2)	**23% (7)**	6% (2)	**23% (7)**	10% (3)	0% (0)	0% (0)	10% (3)	3% (1)	13% (4)	6% (2)	**31**
SS 3011	16% (5)	**35% (11)**	16% (5)	3% (1)	6% (2)	0% (0)	3% (1)	6% (2)	6% (2)	3% (1)	3% (1)	**31**
IS 3502	**23% (7)**	19% (6)	10% (3)	6% (2)	6% (2)	0% (0)	3% (1)	10% (3)	0% (0)	10% (3)	13% (4)	**31**
CC 3000	**45% (14)**	19% (6)	3% (1)	3% (1)	10% (3)	0% (0)	0% (0)	6% (2)	3% (1)	6% (2)	3% (1)	**31**
											Total Respondents	**31**
											(skipped this question)	**7**

14. AFTER completing a DL course, how often did you use those specific skills gained or refined in the fulfillment of your operational billet duties for the following courses? Select N/A if course was not taken.

	N/A	0-10%	10-20%	20-30%	30-40%	40-50%	50-60%	60-70%	70-80%	80-90%	90-100%	Response Total
IO 3100	6% (2)	13% (4)	10% (3)	**16% (5)**	**16% (5)**	3% (1)	0% (0)	0% (0)	**16% (5)**	10% (3)	10% (3)	**31**
SS 3011	19% (6)	**23% (7)**	19% (6)	0% (0)	3% (1)	3% (1)	3% (1)	6% (2)	16% (5)	3% (1)	3% (1)	**31**
IS 3502	**23% (7)**	13% (4)	10% (3)	6% (2)	3% (1)	3% (1)	3% (1)	6% (2)	10% (3)	10% (3)	13% (4)	**31**
CC 3000	**45% (14)**	16% (5)	3% (1)	6% (2)	3% (1)	6% (2)	3% (1)	0% (0)	6% (2)	6% (2)	3% (1)	**31**
											Total Respondents	**31**
											(skipped this question)	**7**

Figure 34. Raw Survey Results Continued



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15. What level of usable knowledge gained or refined from your DL coursework was completely new to you for the following courses? Select N/A if course was not taken.

	N/A	0-10%	10-20%	20-30%	30-40%	40-50%	50-60%	60-70%	70-80%	80-90%	90-100%	Response Total
IO 3100	6% (2)	3% (1)	6% (2)	0% (0)	10% (3)	**26% (8)**	10% (3)	10% (3)	16% (5)	10% (3)	3% (1)	31
SS 3011	16% (5)	3% (1)	3% (1)	6% (2)	3% (1)	3% (1)	3% (1)	13% (4)	**19% (6)**	**19% (6)**	10% (3)	31
IS 3502	**23% (7)**	3% (1)	6% (2)	10% (3)	3% (1)	16% (5)	6% (2)	6% (2)	16% (5)	6% (2)	3% (1)	31
CC 3000	**45% (14)**	6% (2)	3% (1)	0% (0)	6% (2)	10% (3)	3% (1)	10% (3)	3% (1)	10% (3)	3% (1)	31
										Total Respondents		31
										(skipped this question)		7

16. What level of usable knowledge gained from your DL coursework was a refinement of existing knowledge for you from the following courses? Select N/A if course was not taken.

	N/A	0-10%	10-20%	20-30%	30-40%	40-50%	50-60%	60-70%	70-80%	80-90%	90-100%	Response Total
IO 3100	6% (2)	10% (3)	13% (4)	10% (3)	13% (4)	**26% (8)**	13% (4)	0% (0)	10% (3)	0% (0)	0% (0)	31
SS 3011	**19% (6)**	**19% (6)**	10% (3)	13% (4)	10% (3)	13% (4)	3% (1)	0% (0)	10% (3)	3% (1)	0% (0)	31
IS 3502	**23% (7)**	10% (3)	3% (1)	19% (6)	13% (4)	3% (1)	6% (2)	6% (2)	3% (1)	6% (2)	6% (2)	31
CC 3000	**45% (14)**	10% (3)	3% (1)	3% (1)	10% (3)	16% (5)	6% (2)	3% (1)	3% (1)	0% (0)	0% (0)	31
										Total Respondents		31
										(skipped this question)		7

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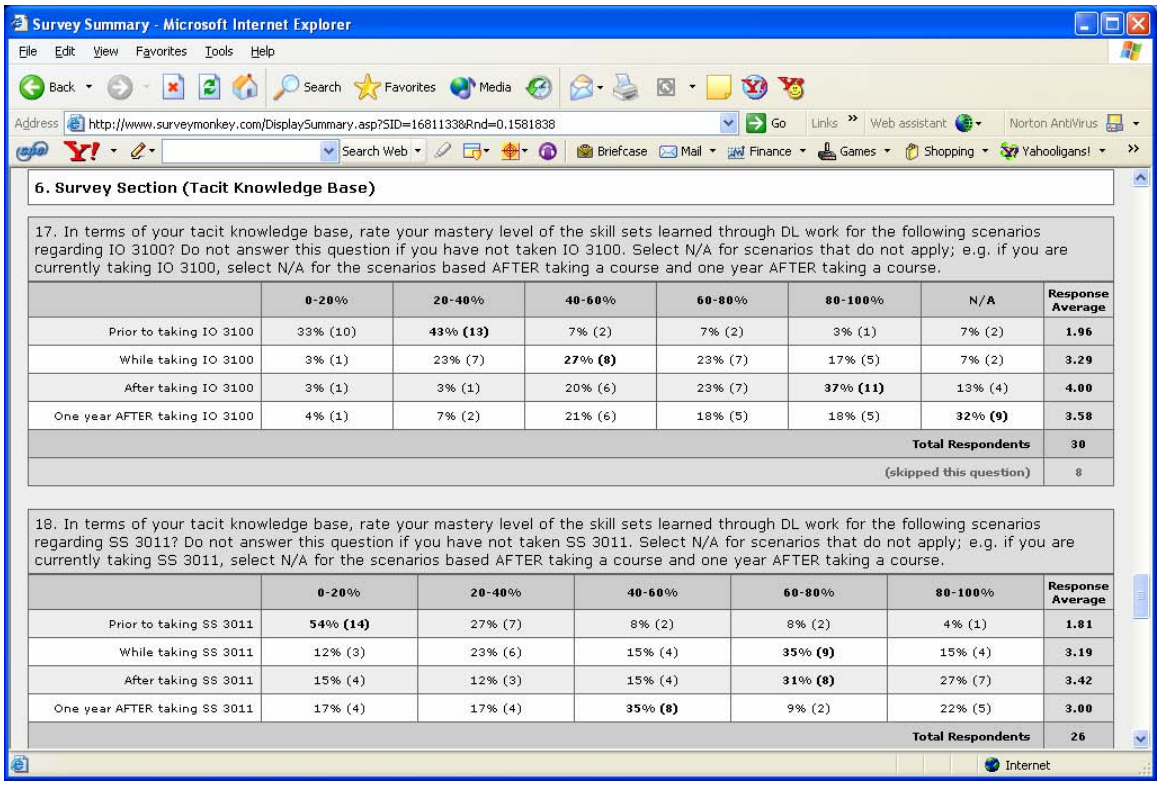
Figure 35. Raw Survey Results Continued



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6. Survey Section (Tacit Knowledge Base)

17. In terms of your tacit knowledge base, rate your mastery level of the skill sets learned through DL work for the following scenarios regarding IO 3100? Do not answer this question if you have not taken IO 3100. Select N/A for scenarios that do not apply; e.g. if you are currently taking IO 3100, select N/A for the scenarios based AFTER taking a course and one year AFTER taking a course.

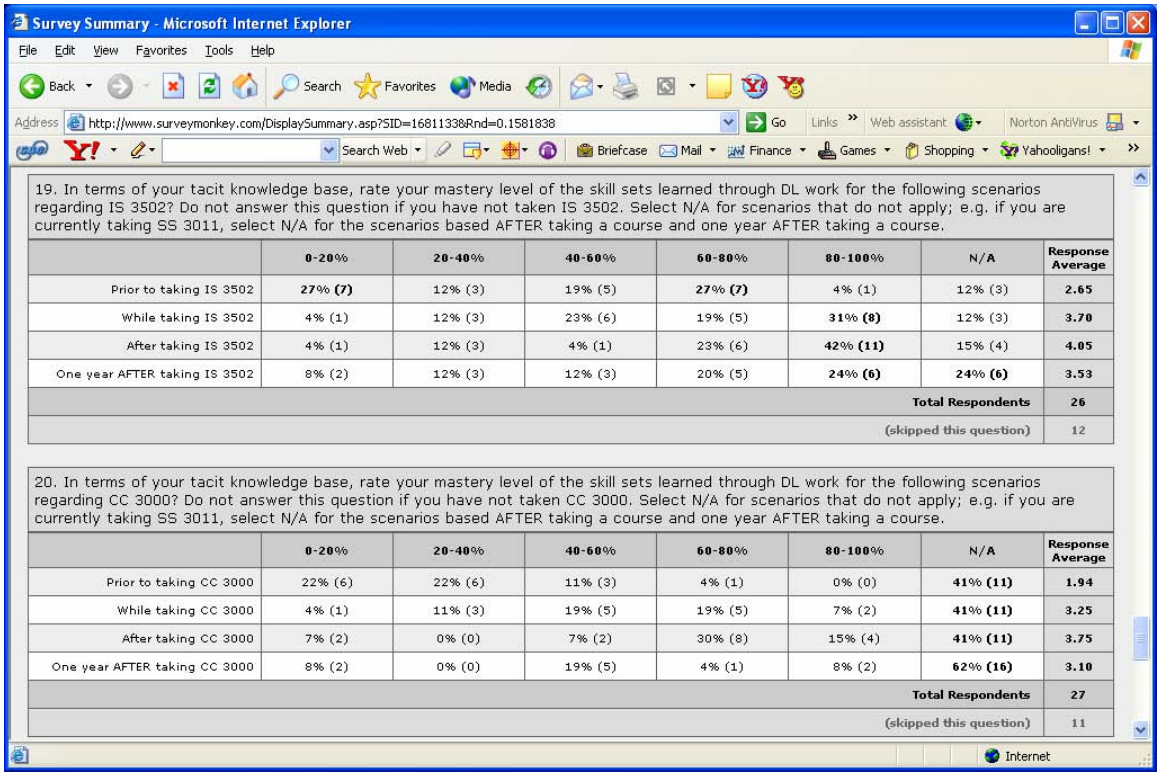
	0-20%	20-40%	40-60%	60-80%	80-100%	N/A	Response Average
Prior to taking IO 3100	33% (10)	**43% (13)**	7% (2)	7% (2)	3% (1)	7% (2)	**1.96**
While taking IO 3100	3% (1)	23% (7)	**27% (8)**	23% (7)	17% (5)	7% (2)	**3.29**
After taking IO 3100	3% (1)	3% (1)	20% (6)	23% (7)	**37% (11)**	13% (4)	**4.00**
One year AFTER taking IO 3100	4% (1)	7% (2)	21% (6)	18% (5)	18% (5)	**32% (9)**	**3.58**
					Total Respondents		**30**
					(skipped this question)		8

18. In terms of your tacit knowledge base, rate your mastery level of the skill sets learned through DL work for the following scenarios regarding SS 3011? Do not answer this question if you have not taken SS 3011. Select N/A for scenarios that do not apply; e.g. if you are currently taking SS 3011, select N/A for the scenarios based AFTER taking a course and one year AFTER taking a course.

	0-20%	20-40%	40-60%	60-80%	80-100%	Response Average
Prior to taking SS 3011	**54% (14)**	27% (7)	8% (2)	8% (2)	4% (1)	**1.81**
While taking SS 3011	12% (3)	23% (6)	15% (4)	**35% (9)**	15% (4)	**3.19**
After taking SS 3011	15% (4)	12% (3)	15% (4)	**31% (8)**	27% (7)	**3.42**
One year AFTER taking SS 3011	17% (4)	17% (4)	**35% (8)**	9% (2)	22% (5)	**3.00**
				Total Respondents		**26**

Internet

Figure 36. Raw Survey Results Continued



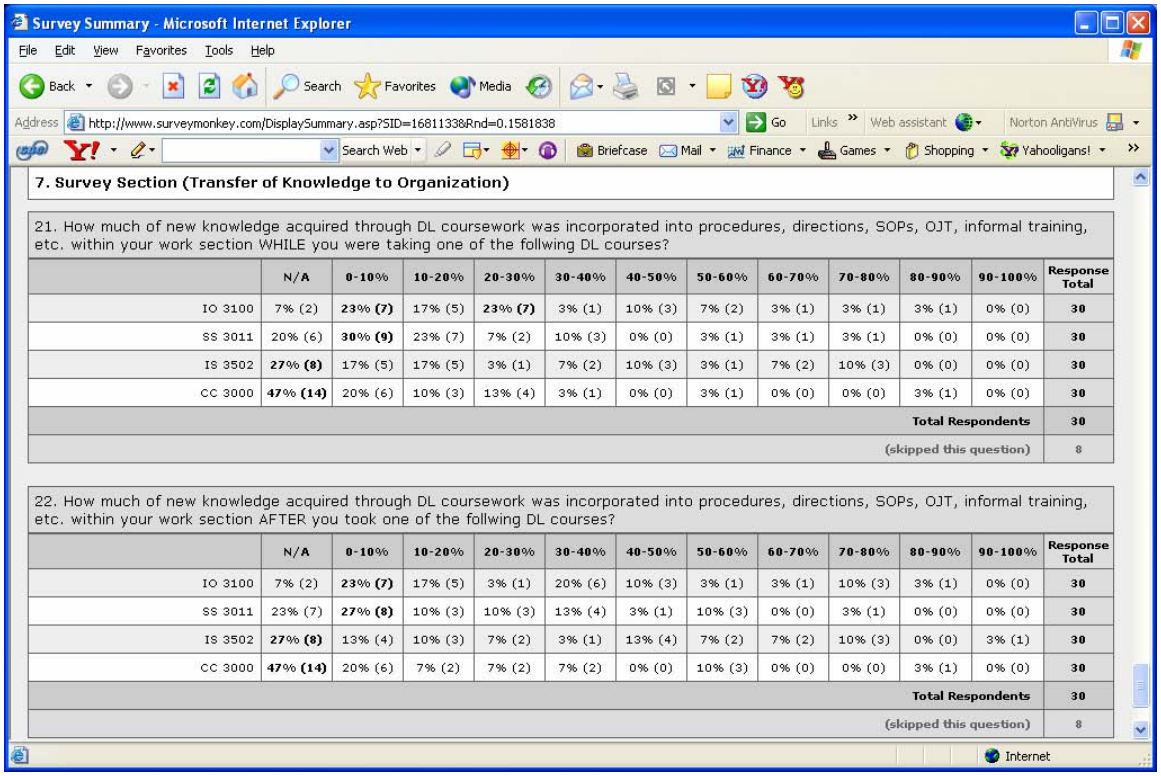
19. In terms of your tacit knowledge base, rate your mastery level of the skill sets learned through DL work for the following scenarios regarding IS 3502? Do not answer this question if you have not taken IS 3502. Select N/A for scenarios that do not apply; e.g. if you are currently taking SS 3011, select N/A for the scenarios based AFTER taking a course and one year AFTER taking a course.

	0-20%	20-40%	40-60%	60-80%	80-100%	N/A	Response Average
Prior to taking IS 3502	**27% (7)**	12% (3)	19% (5)	**27% (7)**	4% (1)	12% (3)	**2.65**
While taking IS 3502	4% (1)	12% (3)	23% (6)	19% (5)	**31% (8)**	12% (3)	**3.70**
After taking IS 3502	4% (1)	12% (3)	4% (1)	23% (6)	**42% (11)**	15% (4)	**4.05**
One year AFTER taking IS 3502	8% (2)	12% (3)	12% (3)	20% (5)	**24% (6)**	**24% (6)**	**3.53**
						Total Respondents	**26**
						(skipped this question)	12

20. In terms of your tacit knowledge base, rate your mastery level of the skill sets learned through DL work for the following scenarios regarding CC 3000? Do not answer this question if you have not taken CC 3000. Select N/A for scenarios that do not apply; e.g. if you are currently taking SS 3011, select N/A for the scenarios based AFTER taking a course and one year AFTER taking a course.

	0-20%	20-40%	40-60%	60-80%	80-100%	N/A	Response Average
Prior to taking CC 3000	22% (6)	22% (6)	11% (3)	4% (1)	0% (0)	**41% (11)**	**1.94**
While taking CC 3000	4% (1)	11% (3)	19% (5)	19% (5)	7% (2)	**41% (11)**	**3.25**
After taking CC 3000	7% (2)	0% (0)	7% (2)	30% (8)	15% (4)	**41% (11)**	**3.75**
One year AFTER taking CC 3000	8% (2)	0% (0)	19% (5)	4% (1)	8% (2)	**62% (16)**	**3.10**
						Total Respondents	**27**
						(skipped this question)	11

Figure 37. Raw Survey Results Continued



7. Survey Section (Transfer of Knowledge to Organization)

21. How much of new knowledge acquired through DL coursework was incorporated into procedures, directions, SOPs, OJT, informal training, etc. within your work section WHILE you were taking one of the follwing DL courses?

	N/A	0-10%	10-20%	20-30%	30-40%	40-50%	50-60%	60-70%	70-80%	80-90%	90-100%	Response Total
IO 3100	7% (2)	**23% (7)**	17% (5)	**23% (7)**	3% (1)	10% (3)	7% (2)	3% (1)	3% (1)	3% (1)	0% (0)	**30**
SS 3011	20% (6)	**30% (9)**	23% (7)	7% (2)	10% (3)	0% (0)	3% (1)	3% (1)	3% (1)	0% (0)	0% (0)	**30**
IS 3502	**27% (8)**	17% (5)	17% (5)	3% (1)	7% (2)	10% (3)	3% (1)	7% (2)	10% (3)	0% (0)	0% (0)	**30**
CC 3000	**47% (14)**	20% (6)	10% (3)	13% (4)	3% (1)	0% (0)	3% (1)	0% (0)	0% (0)	3% (1)	0% (0)	**30**
										Total Respondents		**30**
										(skipped this question)		8

22. How much of new knowledge acquired through DL coursework was incorporated into procedures, directions, SOPs, OJT, informal training, etc. within your work section AFTER you took one of the follwing DL courses?

	N/A	0-10%	10-20%	20-30%	30-40%	40-50%	50-60%	60-70%	70-80%	80-90%	90-100%	Response Total
IO 3100	7% (2)	**23% (7)**	17% (5)	3% (1)	20% (6)	10% (3)	3% (1)	3% (1)	10% (3)	3% (1)	0% (0)	**30**
SS 3011	23% (7)	**27% (8)**	10% (3)	10% (3)	13% (4)	3% (1)	10% (3)	0% (0)	3% (1)	0% (0)	0% (0)	**30**
IS 3502	**27% (8)**	13% (4)	10% (3)	7% (2)	3% (1)	13% (4)	7% (2)	7% (2)	10% (3)	0% (0)	3% (1)	**30**
CC 3000	**47% (14)**	20% (6)	7% (2)	7% (2)	7% (2)	0% (0)	10% (3)	0% (0)	0% (0)	3% (1)	0% (0)	**30**
										Total Respondents		**30**
										(skipped this question)		8

Figure 38. Raw Survey Results Continued

V. DATA ANALYSIS

Since this research is reliant upon a survey as the primary data collection tool and provides qualitative data by its nature, the main concern during analysis is addressing this potential limitations associated with self-report outlined in the data collection chapter. Essentially, the data analysis centers around building charts to reflect the data and then comparing those charts in accordance with the control measure described to minimize self-report. Because "hard" statistical conclusions are difficult to achieve with this type of data and approach, this analysis focuses on how closely the gathered data correlates with expectation based upon the literature review and draws inference from there. One key point for this analysis was the reliance upon the mode as the primary means of comparison. The mode was chosen because as the answer selected most often for a respective question, it reflects the "most right" response across a group that serve in a variety of services and billets. Because the Hypothesis Curve is continuous, it was converted to a discrete graph in order to facilitate comparisons based upon the mode. Figure 39 shows the converted Hypothesis Curve. This chart was constructed by following the Hypothesis Curve; however, it was built to reflect a single course time period.

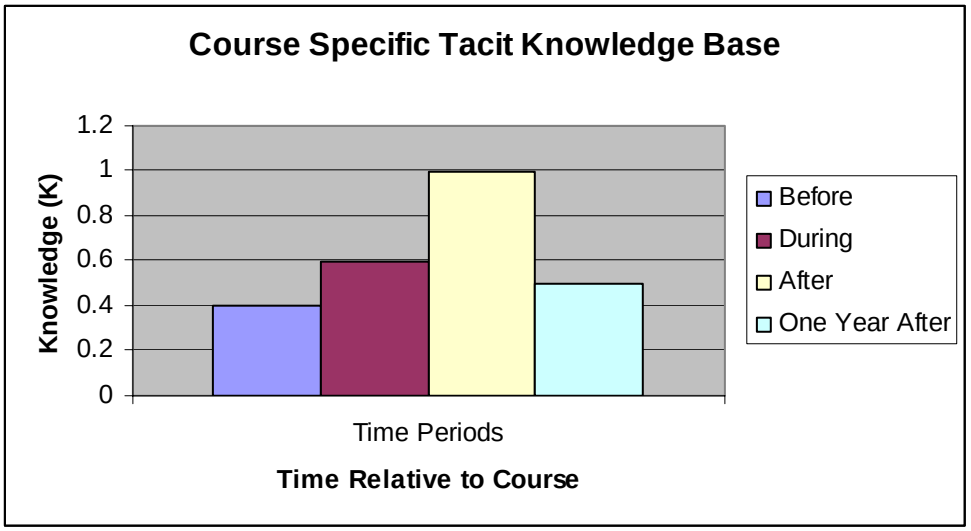


Figure 39. Converted Hypothesis Curve

Respective charts were built in Excel using the modes as the data points for graphing. If the mode for an answer was in the N/A column, the answer with the next most responses for that question was used. If the data reflected a multi-modal response, the average of those modes was used for the chart.

A. IS NPS DL COURSEWORK COMPARABLE TO RESIDENT COURSEWORK IN TERMS OF USABLE KNOWLEDGE GAINED?

For this research question, analysis involved comparing each course individually to the Hypothesis Chart. The Excel CORREL( ) function was used to determine this correlation. The Primary Survey Question Set of questions 17-20 (Tacit Knowledge Base) was used for this comparison. As a means of cross-checking the data, the Associated Question Set of questions 8 and 10 was charted.

1. Individual Course Charts (Tacit Knowledge Base)

The individual class charts for the Primary Survey Question set of questions 17-20 (Tacit Knowledge Base) are as follows:

Tacit Knowledge Base Reported for IO3100 (Question 17)

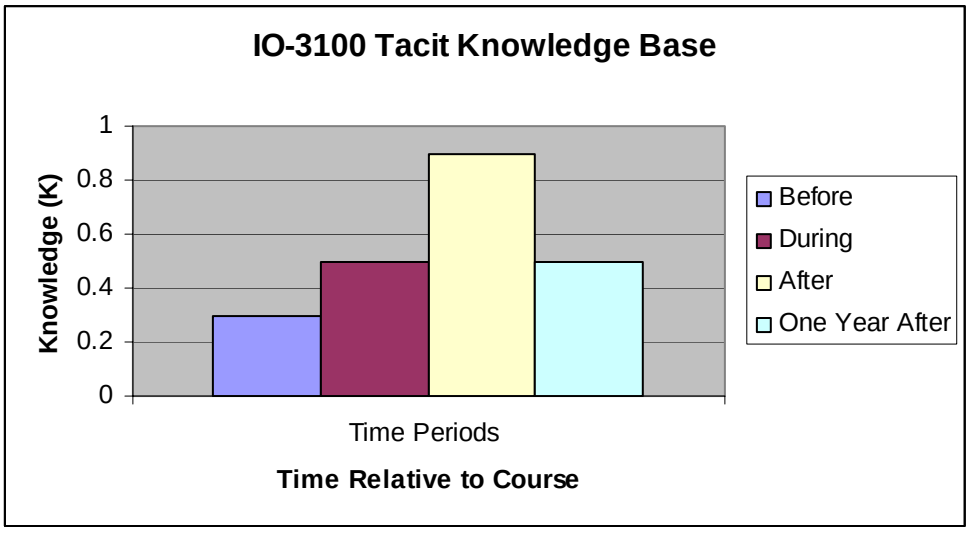


Figure 40. IO3100 Tacit Knowledge Base

Tacit Knowledge Base Reported for SS3011 (Question 18)

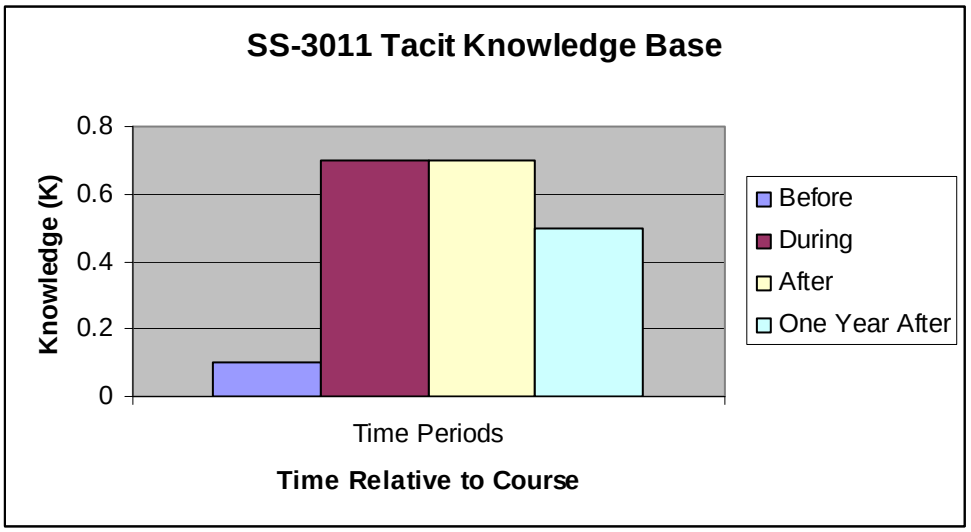


Figure 41. SS3011 Tacit Knowledge Base

Tacit Knowledge Base Reported for IS3502 (Question 19)

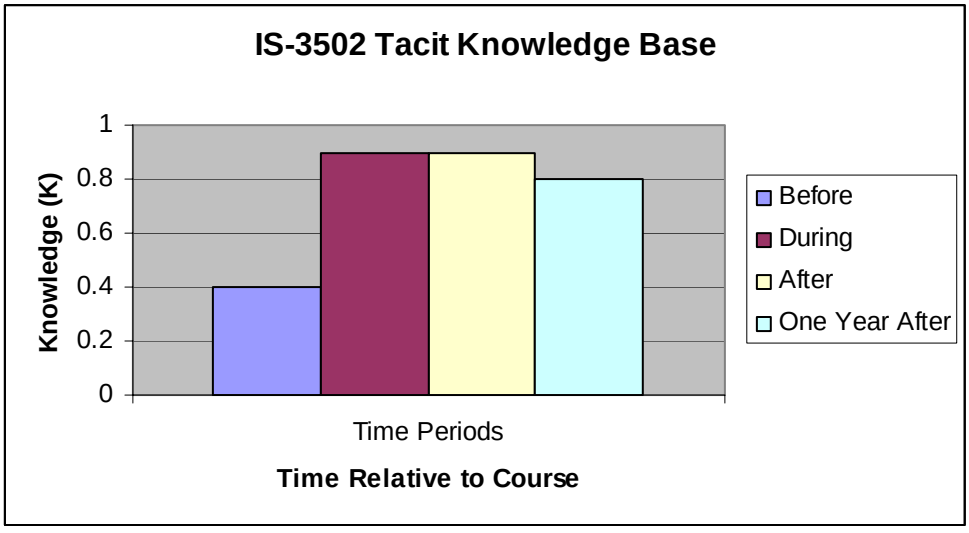


Figure 42. IS3502 Tacit Knowledge Base

Tacit Knowledge Base Reported for CC3000 (Question 20)

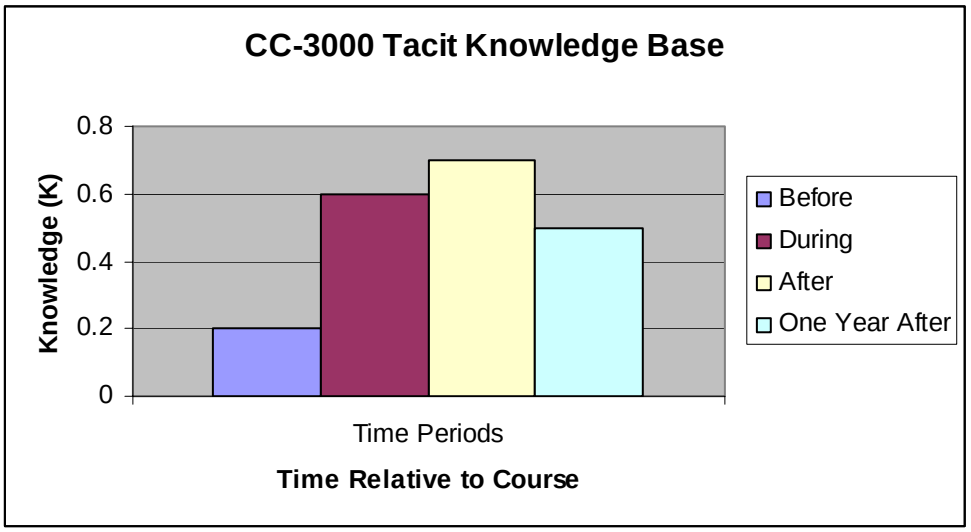


Figure 43. CC3000 Tacit Knowledge Base

2. Correlations Between Individual Course and Hypothesis

Using the Excel CORREL( ) function, the correlations are as follows:

IO3100 to Hypothesis Column Chart:	.98
SS3011 to Hypothesis Column Chart:	.71
IS3502 to Hypothesis Column Chart:	.76
CC3000 to Hypothesis Column Chart:	.78

3. Comparison to Support Tacit Knowledge Base Reports

Question 8 and question 10 provided insight into the level of tacit knowledge held before and then after taking a DL course. Figure 6 depicts those two questions charted side-by-side for comparison purposes. Because there are only two data points in this chart, the Excel CORRL ( ) function cannot be used to make a correlation between this chart and the individual course charts. However, the Figure 6 clearly showed a higher

tacit base of knowledge after completing a course(s) for each course, which does follow the trend observed in the individual course charts.

Chart Merging Question 10 (Before) and Question 8 (After)

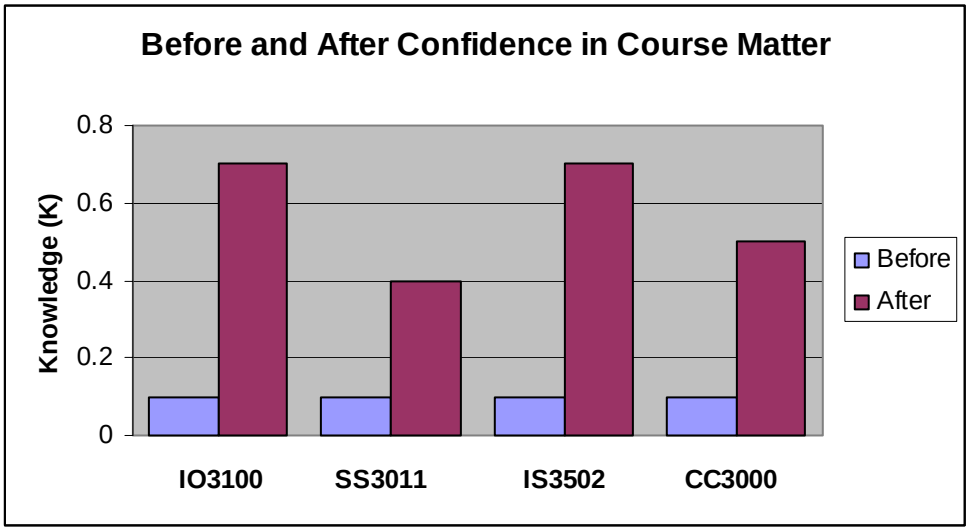


Figure 44. Before and After Confidence in Course Material

4. Observations

The expectation was that the individual course charts would correlate relatively closely with the hypothesis chart. Because the hypothesis chart was a general case built upon literature review, a close correlation demonstrated usable knowledge gained and allowed for the inference of equality between resident and non-resident coursework on that metric. For this research, a relatively close correlation is defined as .80. The range of the correlations for individual classes is .71 to .98. The average correlation for all of the classes, which reflects the ISO program, is .808. The observable trend in Figure 6 strengthened the argument because it clearly depicted a substantial increase of usable knowledge reported.

B. DOES NPS EFFECTIVELY AND QUICKLY DISTRIBUTE GRADUATE – LEVEL SKILLS VIA DL TO THE PERSONNEL SERVING IN THE OPERATIONAL BILLETS?

For this research question, "effective and quickly distribute" means that usable knowledge was gained or refined. The assumption was that new knowledge gained or refined translates to new knowledge applied in the performance of billet responsibilities. In fact, this point is a significant potential advantage of DL coursework, because new knowledge can be applied as it is learned. The Primary Survey Question Set of questions 7-11 (Billet Application) was used to cultivate insight into the reported application of skills to billet responsibilities. Question 9 and 11 were the primary questions for this research question. These questions queried the quality of the DL course(s) in providing applicable skills and use of those skills at work. Question 8 and 10 are focused more on tacit knowledge base and are not used in this research question's analysis. The Associated Question Set of questions 12, 13, and 14 considered with question 7 queried to the application of DL coursework to billet performance in terms of frequency of use and direct application of course materials. The expectation is that questions 9 and 11 will correlate relatively closely suggesting that DL coursework provides applicable skills that were used in the performance of billet responsibilities. Additionally, the expectation is to see a relatively close correlation between the Primary and Associated Question Sets.

1. Correlation Between DL Course Quality and Skill Use

The correlation between the response averages for question 9 and 11 is .96.

2. Comparison Between Frequency of Use and Course Materials

Question 7 asked how much of the course(s) materials applied to current billet responsibilities. Questions 12, 13, and 14 asked how often you used new knowledge gained or refined from DL coursework in your billet responsibilities in terms of time relative to course completion. The modes for each class response to question 7 were in the 0-10% column, meaning that most respondents reported that ten percent or less of the course material applied to their current job. With one exception, IO3100 after course completion, respondents reported their frequency of use of skills gained or refined through DL coursework at 0-10% before, during, and after course completion

respectively. These responses seemed to indicate a connection between course material that directly applies to billet responsibility and the frequency of use of skills gained or refined from that course.

3. Comparison of Question Sets

The Primary Question Set question 9 and 11 had categorical answers of Low, Medium Low, Medium, High Medium, and High. In order to form a comparison between the question sets, those categories required conversion to percentages. For comparison's sake, Low became 0-20%, Medium Low became 20-40%, etc. After conversion, simple observation showed that there is very little correlation between the question sets. Almost all of the response modes for the Primary Question Set were in the 60-80% or 80-100% categories. Conversely, all but one of the responses in the Associated Question Set was in the 0-10% category.

4. Observations

The expectation was that a relatively close correlation existed between the reported quality of DL coursework in providing applicable billet skills and use of new knowledge gained or refined through DL coursework in billet performance. A strong correlation between these two questions demonstrated that students felt like the course(s) are giving them applicable skills that they then use in the performance of their billets. This goes directly to the heart of this research question and gave evidence that NPS does effectively and quickly distribute graduate – level skills via DL to the personnel serving in the operational billets. Since the correlation between these two questions' response averages was .96, strong evidence exists that NPS DL is succeeding in this mission. While a tight relationship existed among the questions in the Associated Question Set, the relationship between the two question sets was not closely correlated at all. The expectation was to see a relatively close correlation between these two question sets. The responses in question 9 and 11 clearly demonstrated that students feel they are receiving quality knowledge and reported using that knowledge 60-100% of the time in billet performance. A possible reason for the lack of agreement is that the respondents see a difference between knowledge (Primary Question Set) and skills (Associated Question Set).

C. IS THERE ANY TRANSFER OF KNOWLEDGE FROM A DL STUDENT TO THEIR ORGANIZATION?

While the bulk of this research focuses on the usable knowledge gained by personnel, this research question seeks insight into how much of that new knowledge gets left behind in the organization after the DL student rotated to another billet. The foundation of this question was based upon the level of codified knowledge that remains in a work section for future personnel to employ. The Primary Question Set of questions 21 and 22 (Transfer of Knowledge to the Organization) queried to the amount of new knowledge gained or refined through DL coursework that is incorporated into OJT, SOPs, procedures, etc. within the student's work section before and after taking a DL course(s) respectively. The Associated Question Set of questions 7, 12, 13, and 14 queried frequency of use of specific skills gained or refined through DL in the work section and course material applicability to the work section. The expectation is that a transfer of knowledge occurs between DL students and their work section. Part of this expectation is based upon the environment of being able to use some skills while learning them. The amount of transfer is expected to be somewhat low because the questions specifically primarily seek codified knowledge; however, some aspects of the questions such as OJT and informal training open the question to person-to-person knowledge transfer. Either way, tacit to explicit knowledge transfer is expected to be relatively low in this research because these types of transfers, Externalization and Socialization, require thoughtful interaction and discourse, which may or may not be part of a military work environment that is mission-oriented [Nonaka 2003]. Additionally, the personnel turnover rate inherent to a military work section restricts long-term interaction between personnel. The expectation is that the Associated Question Set will support the Primary Question Set because the skills used in the work section will most likely be the ones codified for the future.

1. Direct Query of Knowledge Transfer to the Organization

Question 21 asked how much of the new knowledge gained or refined through DL was codified in the workplace while the student was taking the DL course(s), and question 22 asked the same question except the time frame was changed to after

completion of the course. In both cases, for each course, the reported percentage of transfer was 0-10%. While this result was low, it did relatively match the expectation.

2. Use of Skills Compared to Transfer of Knowledge

Question 7 asks how much of the course(s) materials applied to current billet responsibilities. Questions 12, 13, and 14 ask how often you used new knowledge gained or refined from DL coursework in your billet responsibilities in terms of time relative to course completion. The modes for each class response to question 7 were in the 0-10% column, meaning that most respondents reported that ten percent or less of the course material applied to their current job. With one exception, IO3100 after course completion, respondents reported their frequency of use of skills gained or refined through DL coursework at 0-10% before, during, and after course completion respectively.

3. Observations

This very close match between the Primary Question Set and the Associated Question Set provided evidence that there was a transfer of knowledge to the organization and that it was proportional to the frequency of use of specific skills gained or refined through DL.

D. CAN FREQUENCY OF USE OF SKILLS LEARNED THROUGH DL BE USED AS A MEASURE OF EFFECTIVENESS FOR THE DL PROGRAM AT NPS?

This research question was focused towards further research. It attempted to evaluate frequency of use as potential metric for measuring the effectiveness of DL coursework in delivering usable knowledge. The genesis for this metric was the assumption that usable knowledge will be used. Identifying a concrete measure of effectiveness provides a valuable tool for analysis in the future. The Primary Question Set of questions 12 through 14 (Usable Knowledge Gained or Refined) queried directly to the frequency of use of skills gained or refined through DL course(s) time relative to the course. The Associated Question Set of questions 9 and 11 queried the quality of the DL course(s) in providing applicable skills and use of knowledge gained or refined at

work. The expectation was a high correlation between the question sets. A related expectation was that frequency of use would increase time relative to the start of the course, i.e., the farther along in a course a student was, the more knowledge in use in the workplace.

1. Direct Query of Frequency of Use

The Primary Question Set of questions 12, 13, and 14 queried the frequency of use of skills gained or refined through DL coursework before, during, and after taking a DL course. All but one of the response modes for each class in each time relative period was 0-10%. However, the modes' values grew successively smaller from the before to during to after question. The degree of that shift was determined by computing a weighted averages from the before, during, and after responses. The weighted average method applied by the survey tool is as follows:

- assign a multiplication value of 1 for the leftmost column of answers and increments by 1 until the rightmost column is reached
- multiply the value by the number of responses in that column
- add the columns and divide by the number of columns

The weighted averages for the Primary Question Set are as follows:

- Before (question 12)
    - IO3100: 11.7
    - SS3011: 7.5
    - IS3502: 11.3
    - CC3000: 7.6
- During (question 13)
    - IO3100: 11.7
    - SS3011: 7.8
    - IS3502: 11.1
    - CC3000: 7.3
- After (question 14)
    - IO3100: 13.6

- SS3011: 9.9
- IS3502: 12.8
- CC3000: 7.7

2. Comparison of Frequency of Use of Skills and of Knowledge

The responses in the Associated Question Set of questions 9 and 11 demonstrated that the students believe they received usable knowledge from their DL course(s). The survey tool generated a response average for these two questions. Question 9 asked for the student to rate the quality of the DL course(s) in terms of providing applicable skills for their billet. The range of the response averages was 2.2 to 2.85, and the average of the response averages was 2.55, which translates to the 51st percentile. Question 11 asked for the student to rate their use of knowledge gained or refined from DL courses at work. The range of the response averages was 2.44 to 3.19, and the average of the response averages was 2.76, which translates to the 55th percentile

3. Observations

The mode for the reported frequency of use of skills gained or refined through DL remained in 0-10% range for almost all of the courses for the before, during, and after time periods. However, there was some reported increase in skill use for the "after" time period reflected in the weighted averages, which was more pronounced in the two more technical courses. Interestingly, question 11 which states "Rate your use of knowledge gained or refined from DL course(s) at work" resulted in an average response that translated to a 55th percentile. The difference between the results for this question and questions 12, 13, and 14, i.e., 55% compared to 0-10%, for basically the same question except for the use of "knowledge" in question 11 instead of "skills" in question 12, 13, and 14 again leads to the possible distinction between these two terms for the students.

E. INTERESTING POINTS

The survey generated a couple of interesting points that are potentially significant for further research.

- Question 6 reported a 68.8% response choosing the interaction and exchange with fellow students as the preferred learning context for these DL students. Even more interesting, interaction and exchange with the instructor received a 9.4% response with the remaining balance of 21.9% of the responses preferring the context of working alone. The cumulative response for interaction and exchange between other students and the instructor was 78.2%. The reason this is interesting is that traditional thinking cites the lack of social interaction among students and staff as a significant hurdle for the DL learning modality in terms of delivering the same quality of education as resident coursework [Branstetter 2002 p.76]. This response provided evidence to counter that assertion.
- There is almost a 100% correlation between the modes for questions 7, 12, 13, 14, 21, and 22, which suggested a linkage between course material that applies to current billet, frequency of use of specific skills gained or refined in a DL course, and the percentage of that knowledge that becomes embedded into the organization.
- Students seemed to perceive a difference between "use of knowledge gained or refined" and "use of skills gained or refined".

F. FOLLOW-UP INTERVIEWS

Because a difference existed between the expected relationship and reported results on questions that examined the use of knowledge gained or refined as compared with skills gained or refined in the workplace, a follow-up interview was conducted to gain insight into what caused that difference. Additionally, the follow-up interview was designed to get a little more demographic information as well as insight into the education versus skills question. The demographic information on rank, service, and billet was included to develop any relationship between the specific skills required for a billet and the skills gained or refined through an individual DL course(s). Essentially, one course in the certificate program may provide many skills directly related to billet

performance while the other courses provide a more theoretical or educational benefit that was not as easily quantified by the DL student.

1. Follow-up Interview Questions

The questions were as follows:

- What was your rank when you took the DL courses?
- What was your service?
- What is your current billet?
- Did you take all four courses in the Certificate Program?
- Do you perceive a difference between use of graduate knowledge and use of graduate skills? If so, please give a brief explanation of that difference.
- Have skills from a specific course(s) applied directly to your job much more than skill sets covered in other courses?
- Do you see an indirect positive effect at work from graduate classes that may not have a large amount of directly applied skills for your current billet?

2. Follow-up Interview Results

On April 13, 2006, a follow-up interview was conducted via telephone with a Lieutenant in the U.S. Navy that had completed all four of the courses in the ISO Certificate Program. His billet at the time of the interview was a Maintenance Management Control Officer. His primary Designator was as an Aerospace Maintenance Duty Officer, but he wants to make a lateral move into the Information Professional specialty. This interview's results are as follows:

- Do you perceive a difference between use of graduate knowledge and use of graduate skills? If so, please give a brief explanation of that difference.

  Yes, the difference is related to Military Occupation Specialty and to personal goals. Knowledge can be applied in a much broader context than graduate skills. Graduate knowledge can help develop a better understanding of the big picture and help prepare for pursuit of future personal goals. For example, the ISO Program helped me have a better understanding of NMCI. It also makes me more competitive for promotion or a lateral move into the Information Professional community. Use of graduate skills really depends upon your billet. For instance, I see

more use for specific skills during the pre-deployment workup cycle [Toribio 2006].

- Have skills from a specific course(s) applied directly to your job much more than skill sets covered in other courses?

  Yes, SS3011 and IO3100 provided specific skills I can apply during the pre-deployment workup cycle. I can see how IS3502 provides specific skills that I may be able to use dealing with the NMCI in the future [Torbio 2006].

- Do you see an indirect positive effect at work from graduate classes that may not have a large amount of directly applied skills for your current billet?

  Yes, especially if you have an interest in that subject area. Because education makes you more competitive for promotion and other opportunities, you are more motivated to continue to excel in your job [Torbio 2006].

On April 18, 2006, a second follow-up interview was conducted via email with Edward Basquill, a City Engineer for the City of Radcliff, Kentucky that had completed all three of the courses in the ISO Certificate Program. He was a LCDR in the USNR when he started the program and served as an IAP in that capacity. This interview's results are as follows:

- Do you perceive a difference between use of graduate knowledge and use of graduate skills? If so, please give a brief explanation of that difference.

  Skills are the ability to perform, whereas education is accumulated knowledge. Example: Information Operations provided a case study on operation overload, which lends itself to the skill of conducting an IO, whereas the Sun Tzu stuff was more literary, educational, or philosophical [Basquill 2006].

- Have skills from a specific course(s) applied directly to your job much more than skill sets covered in other courses?

  Yes. Although I am a civilian, the IO class relates well to marketing and dealing with the media in a technical job [Basquill 2006].

- Do you see an indirect positive effect at work from graduate classes that may not have a large amount of directly applied skills for your current billet?

Yes. For example, I applied some of what I learned in how I designed a public outreach website as part of my job for the environment [Basquill 2006].

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VI. CONCLUSION

Conclusions for this research were developed through discussion of the survey results in the context of individual research questions. Establishing conclusions for this research provided the opportunity to recommend possible methods assessing and expanding the NPS DL program's effectiveness in transferring usable knowledge quickly to military operations. A more robust capture of demographic information makes sense for future research to maximize analysis and results.

A. DISCUSSION OF RESULTS

1. Is NPS DL Coursework Comparable to Resident Coursework in Terms of Usable Knowledge Gained?

The observations made in the Data Analysis chapter for this research question present a .81 correlation between the Hypothesis Curve and the ISO certificate program as derived from the individual courses in terms of usable knowledge gained. This correlation, which was based upon a general case built from literature review, verified that students gained usable knowledge from the DL coursework in the ISO certificate program. Drawing a comparison between DL and resident coursework at NPS required finding a measure of resident coursework's ability to provide usable knowledge. As part of his December 2002 NPS thesis, Terry Branstetter measured the usefulness of the fourteen educational topics in the Information Systems Technology (IST) in the fulfillment of Military Occupational Specialty (MOS) 9648 billet responsibilities. His research was conducted using Marine Corps Officers that had completed the IST curriculum at NPS and were serving in a tour utilizing that education or had completed that "payback" tour. Figure 45 captures the educational usefulness of the topics in that curriculum and usefulness was described as topics useful to fulfillment of billet responsibilities.

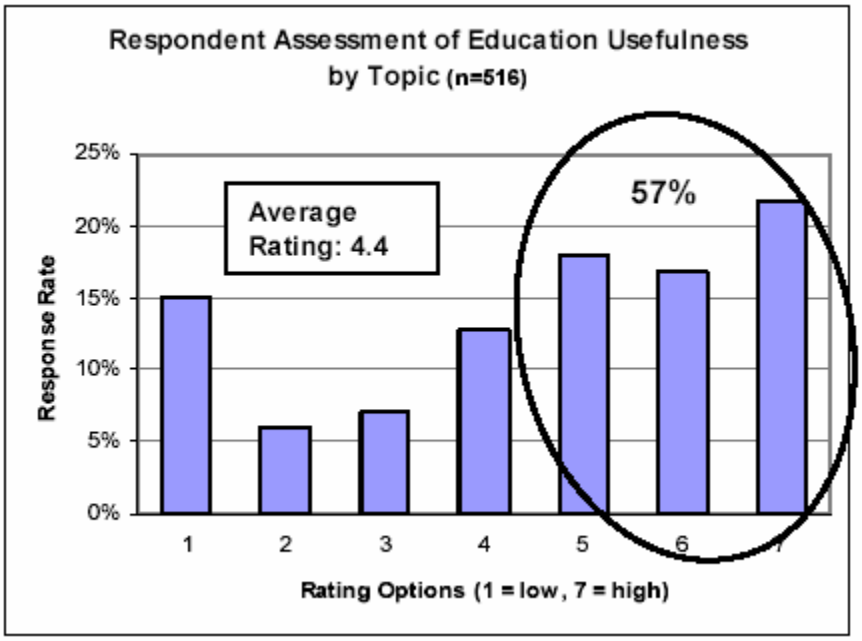

Figure 45. Assessment of Education Usefulness (From Branstetter 2002)

Branstetter further developed this point by polling personnel that were no longer serving in a "payback" capacity. Those results are captured in Figure 46.

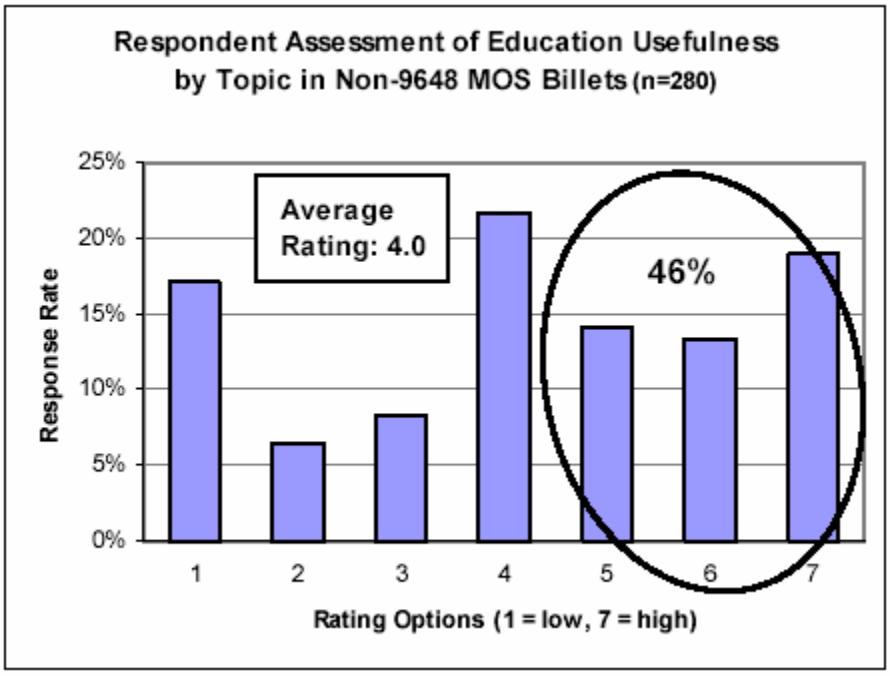

Figure 46. Education Usefulness in General Billets (From Branstetter 2002)

This is an important distinction because the educational usefulness reported in Figure 46 is in billets that are not specifically designed to leverage the graduate skills learned at NPS. In fact, the normal rotation from a USMC "payback" tour is into the operating forces. Since the student population of interest for this DL research is serving in operational billets, Figure 46 provided better data for comparison for this research question than the data presented in Figure 45. Figure 45 is included to provide a comparison for the two population characteristics. The survey for this research posed a question that asked the respondents to rate their use of knowledge gained or refined from DL coursework at work in question 11. With the assertion that using knowledge at work is equivalent to rating the educational usefulness of specific IST topics in billet performance, a comparison of question 11's results to the data presented in Figure 45 and 46 from Branststter's thesis provided an almost direct comparison. The average response average for question 11 was 2.76, which translates to an average response of the 55.2 %. The DL survey reported response of 55.2% compared closely with the 57% reported in Figure 45 and the 46% reported in Figure 46. Clearly, DL coursework is comparable to resident coursework in providing useable knowledge gained.

2. Does NPS Effectively and Quickly Distribute Graduate-Level Skills via DL to the Personnel Serving in Operational Billets?

Question 9 focused on the quality of the DL course(s) in terms of providing applicable skills for current billet. The response average for this question was 2.55, which translated to 51%. This result was relatively close to the Branstetter findings presented in Figure 46, which was conducted on a similar demographic, i.e., personnel serving in operational billets. Additionally, a .96 correlation between question 9 and question 11, which asked the respondents to rate their use of knowledge gained or refined from DL coursework at work, further solidified the result form question 9. Coupled with the fact that DL students are learning and doing at the same time, the response from question 9, which is buoyed by the high correlation with a related question in the same survey and a strong supporting relationship to results from the Branstetter thesis, NPS does effectively and quickly distribute graduate-level skills via DL to personnel serving in operational billets.

3. Is There any Transfer of Knowledge from a DL Student to their Organization?

The responses for questions 21 and 22, which directly queried to transfer of knowledge form the individual to the organization, conclusively show that a transfer of knowledge to the organization did occur. The observations from the Data Analysis chapter for this research question proposed a proportional linkage between the amount of knowledge transferred and the frequency of use of specific skills gained or refined through DL coursework in the workplace. Beyond that apparent linkage, question 7, which asked how much of the course material applied directly applied to their current billet, appeared to be proportionally linked to the other two responses as well. This relationship supported the point developed as an interesting point in the Data Analysis chapter that involved the linkage between course material that applied to current billet, frequency of use of specific skills gained or refined in a DL course, and the percentage of that knowledge that became embedded in the organization. The ultimate relationship between course materials that directly applied to current billet and the amount of knowledge embedded into the organization was not strong enough to suggest a causal relationship. The data provided enough support to conclude that course material that directly applied as an usable skill in the workplace was a related to the frequency of use of specific skills in the workplace and frequency of use of specific skills in the workplace was related to the amount of knowledge that was embedded into the organization.

4. Can Frequency of Use of Skills learned Through DL be Used as a Measure of Effectiveness for the DL Program?

Frequency of use was shown to be a reliable measure of effectiveness in resident coursework at NPS in the Branstetter thesis. Figure 47 captures the reported frequency of use of skills learned in the IST curriculum by Marine Corps Officers during their "payback" tour billets. Additionally, this data was similar in percentages reported to other data sets that presented responses capturing the value of theoretical knowledge and practical skills in the workplace. This data was used by Branstetter as a strong element of support for concluding that the NPS IST program significantly impacted Marine Corps 9648 MOS billets [Branstetter 2002].

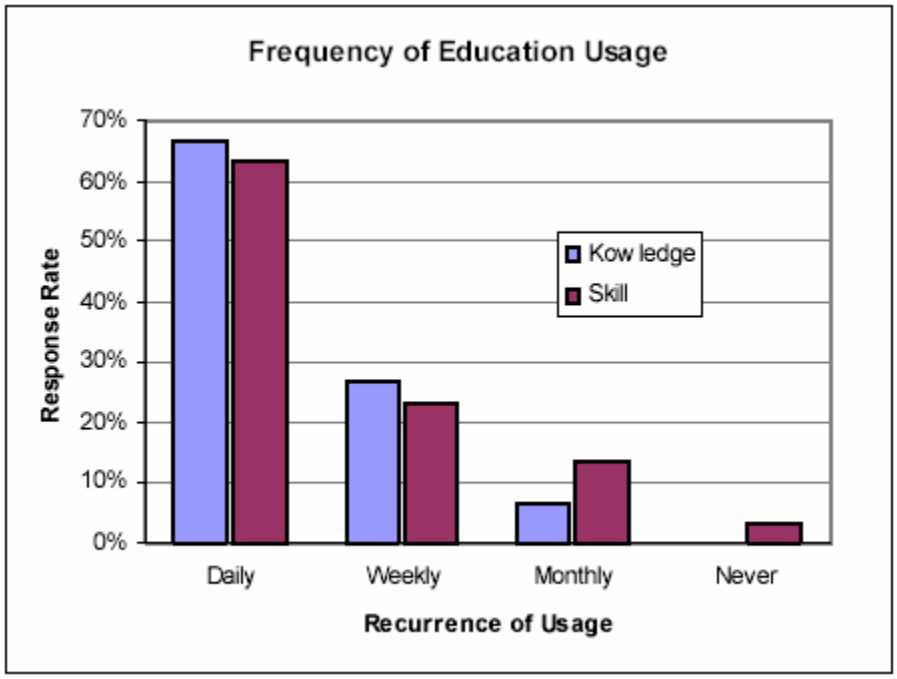

Figure 47. Frequency of Use (From Branstetter 2002)

Acknowledging that frequency of use of skills was shown to be a measure of effectiveness in the Branstetter thesis, this research cannot conclude that frequency of use can be used as a measure of effectiveness for the DL program. The inconsistent responses between questions that queried to knowledge gained or refined through DL as compared to skills gained or refined as described in the Data Analysis chapter is the reason that no conclusion can be drawn. The suppositions that respondents perceived a distinction between knowledge and skill was one possible reason for this disconnect. In fact, the follow-up interview reported a distinction between knowledge and skills. Another possible reason for this disconnect is that perhaps the respondents do not consciously realize the amount of knowledge internalized and therefore cannot specifically differentiate between new knowledge and previous knowledge when it is applied in the workplace. Essentially, once knowledge becomes implicit, it is difficult to articulate. For example, in the follow-up interview, the Navy Lieutenant speculated that skills learned in IS3502 may help him in the future concerning NMCI integration in his Command; however, he reported the ISO program helped him have a better understanding of NMCI when he was differentiating between knowledge and skills

[Toribio 2006]. His responses suggest a perception that unless he was technically applying skills such as packet captures or IP addressing, then he may be using his new knowledge but not new skills. Those responses also suggested he did not perceive "having a better understanding of NMCI" as applying his new knowledge or skills. Only one follow-up interview was conducted because out of three known respondents contacted for follow-up interviews, only one respondent agreed to participate. Therefore, no conclusion can be drawn from the follow-up interview because it is only one data point. While the follow-up interviews were suggestive, more interviews are needed to verify the results from these two interviews.

B. RECOMMENDATIONS TO NPS FOR DL

1. Aggressively Promote Distributed Learning to the Services

Distributed Learning provides tangible benefits to the Services because it delivers graduate-level education and skills to personnel while they are serving in operational billets. This is a clear advantage of DL over resident coursework. In fact, in many instances, resident students do not go straight to an operating force billet after graduating from NPS, so it may be as long as three years after a student graduates before they again serve in an operational billet. Beyond the immediacy provided by DL for the Services, this research demonstrated that DL is comparable to resident coursework in delivering graduate skills and education and that a percentage of that knowledge became embedded into techniques and procedures within the student's workplace. From the follow-up interview, the notion of DL coursework making a person more competitive for promotion provides a key point as well. Personnel that are motivated enough to seek graduate-level education while serving in the operating forces are most likely focused on competing for promotion and challenging billets in the future, and the larger the group of motivated, talented people competing for promotion and command, the better for the organization. All of these points are definite selling points for the DL program, because they all directly benefit the Services. NPS should be looking to aggressively promote DL and expanding its DL program because of the service it provides the operating forces.

2. Solicit Input for Course Material from Commands

Since there appeared to be a linkage between course material that applied directly to billet performance and the ultimate percentage of knowledge transferred to the organization, providing a method for Commands to request specific skills needed in billet performance allows NPS DL to accommodate those skills as much as possible. The benefit for this process is that the Commands become more involved and receive the benefit of having needed skills and knowledge transferring to their sections. Commands that feel involved in the process and satisfied in the resulting product will become advocates for the NPS DL program within the Services.

3. Establish and Maintain Student Contact and Demographic Information

A key challenge in fielding the survey was the lack of student contact or demographic information easily available at NPS. Student contact information was not tracked at all in Python and could not be produced. The only contact information available was through the Academic Advisor for the ISO Certificate Program. Those records consisted mainly of civilian email addresses and were heavily biased towards current students. The large number of "address not available" error message received when the survey was fielded confirmed this assertion. A central repository for current DL students in every curriculum provides a means for credible query across the entire program. Because the student population is largely active duty military, there is no reason that contact information cannot be maintained on a student as long as they remain in the active duty forces. Having reliable contact information allows for a continuous feedback mechanism for DL coursework and program management, which allows the DL program to constantly challenge and modify the courses in order to provide the most current, applicable product.

C. OPPORTUNITY FOR FUTURE RESEARCH

The primary opportunity for future research provided by this study is developing the frequency of use metric as a measure of effectiveness for DL. The survey design did not collect enough demographic information to make reasonable suppositions about why

a perceived difference between knowledge and skills existed among the survey population. Information about rank, service, billet, and billet responsibilities would have been extremely helpful in that regard. Even better than just a survey as a data collection tool would be a student logbook maintained throughout a course that noted the number of times specific skills learned in class were used in the workplace. Perhaps that could be a class project or offered for extra credit within the course(s) being studied.

Another potential research opportunity would be to replicate a similar study but do it from the organization's point of view. This would involve surveys and interviews with the student's immediate supervisors. Data from this point of view would help solidify the conclusions made in this research and provide more insight into the benefit of DL for the organization.

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